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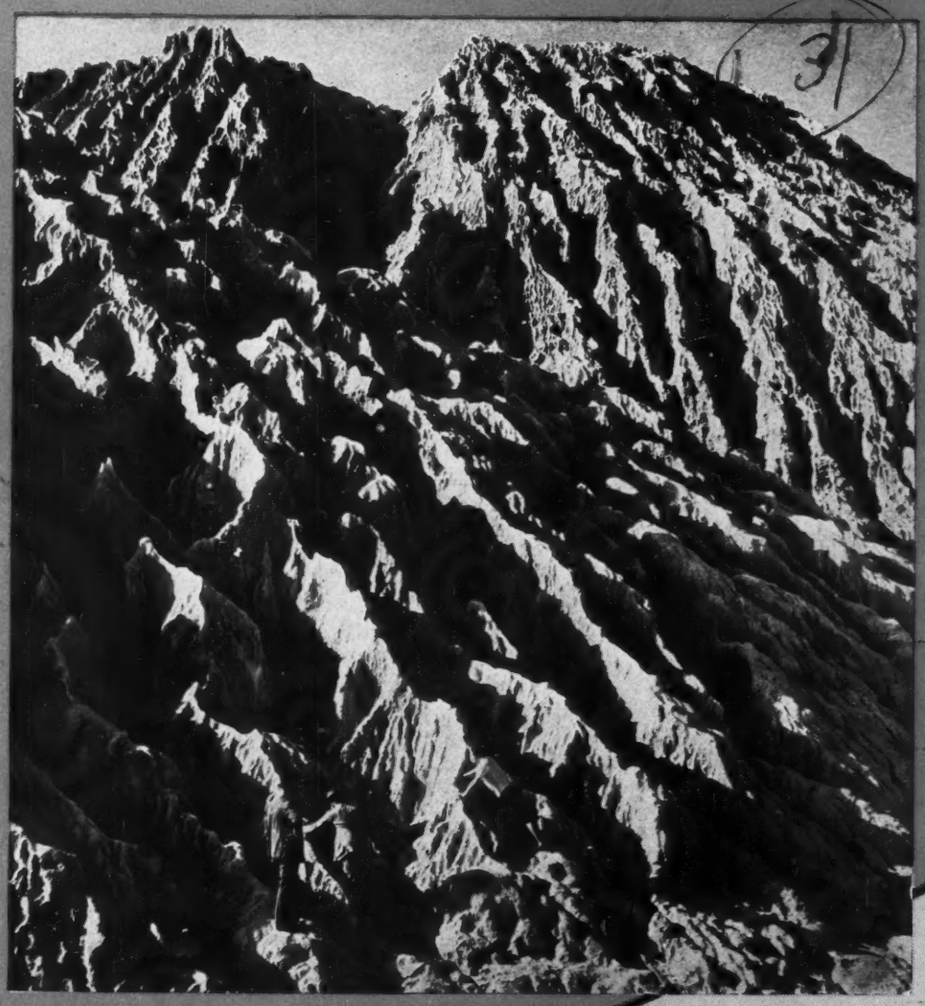
MARCH, 1940



Erosion on the Rand. Weathering of slime tailings on a gold property at Johannesburg, South Africa

In this issue

De-leading Zinc Concentrates at the Pend Oreille Mill
An Operating Man Visualizes Tomorrow's Mining Methods
Recent Uses of Charcoal as a Gold Precipitant
New Federal Census of the Mining Industry

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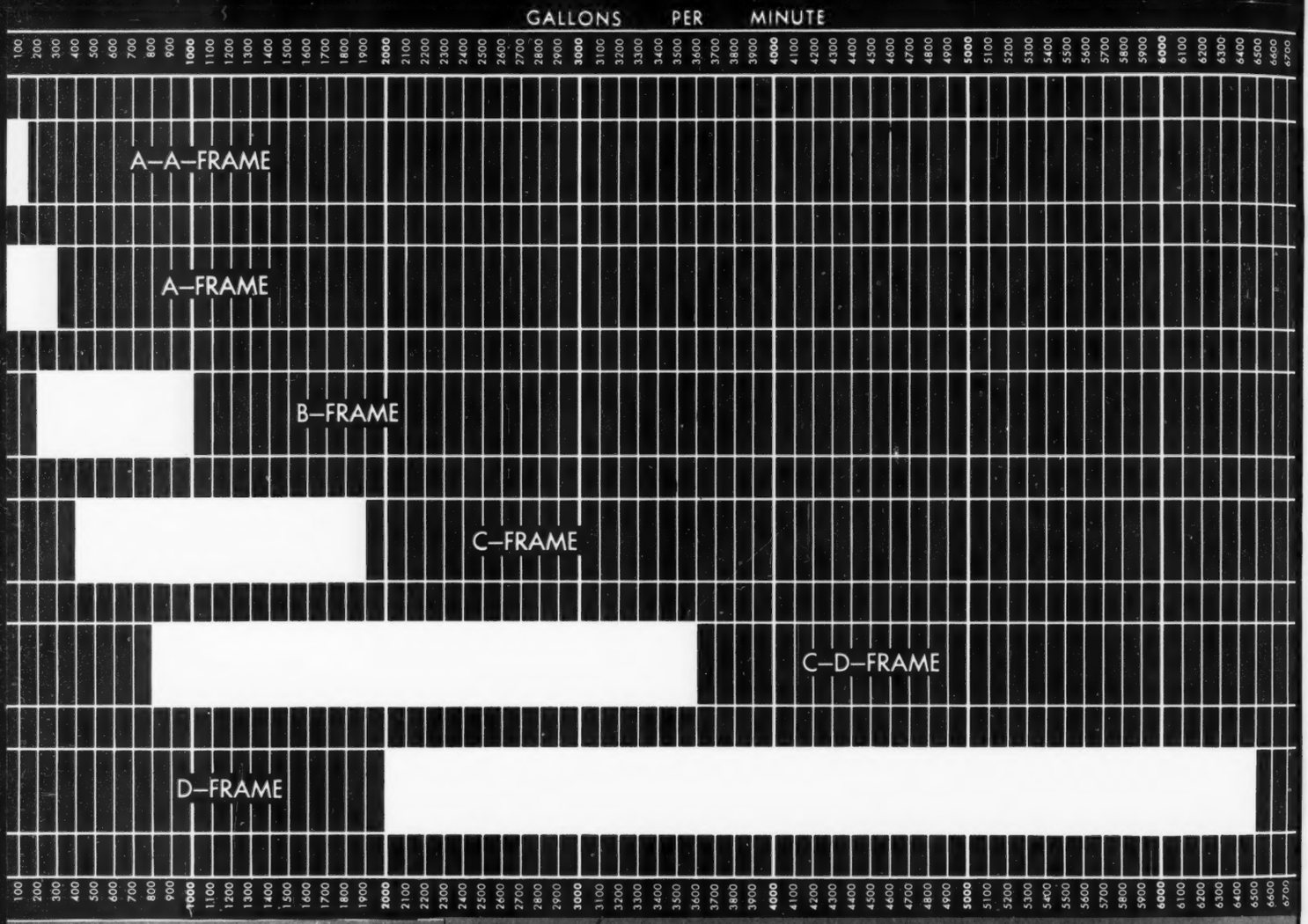
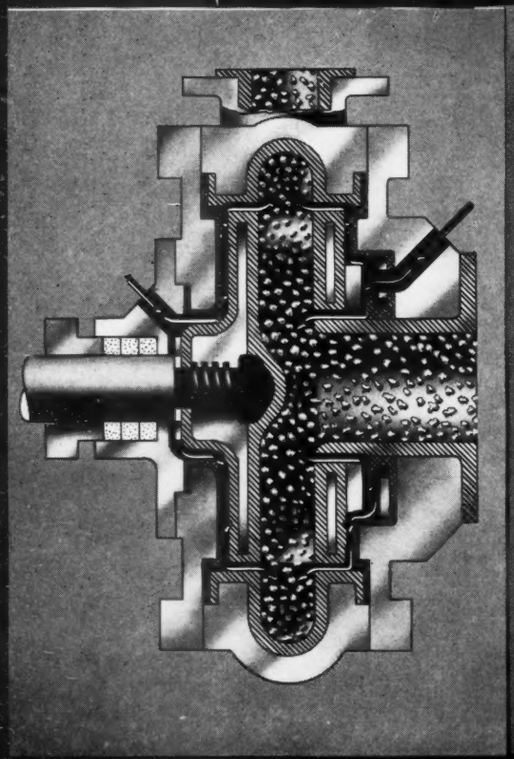
High Efficiency At Various Capacities





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Flotation Phonetics will be the topic of A. F. Taggart, professor of mineral dressing at Columbia, writing in the April issue. Those who would consider it worth while to be able to record in a line or two the important steps of a lengthy flowsheet will find his novel procedure of interest.

▼

Quicksilver being in the limelight, experiments in the concentration of its ores invite attention, all the more because such milling has never been widely practiced. Recent work at the Idaho School of Mines indicates that cinnabar is readily floatable with a wide variety of reagent combinations, the opinion being expressed, however, that the success of such concentration must wait until it is cheaper than furnacing the ores direct. These tests will be described in the *Journal* next month by L. H. Shaffer, Joseph Newton, and A. W. Fahrenwald, under whose direction the work was done.

▼

Philippine resources of base metals grow steadily in importance — for Japan. Thus writes Ralph Keeler, *E. & M. J.* correspondent at Manila. In an article next month he will deal with the known deposits of iron, chrome ore, and manganese in the Islands, the companies exploiting them, the present situation, and the outlook for the future.

▼

Arbiter of disputes, the U. S. Board of Geographical Names rules in favor of Arsenic Bank, in Florida; Chrome Creek, in Oregon; Garnet Gulch, Alaska; Iron Lake, Wis.; Gold Hill (two of them), in Alaska; Golden Rapids, Maine; Porphyry Gulch, Alaska; Scheelite Pass, in Washington; and Soda Creek, Alaska. It also primly expresses its preference for Bayou Colyell, Louisiana, instead of Bayou Go-to-Hell.

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: Erosion on the Rand. Weathering of slime tailings on a gold property at Johannesburg, South Africa. Photo by British Press Combine. (Cover space released for editorial use by Ingersoll-Rand Company)

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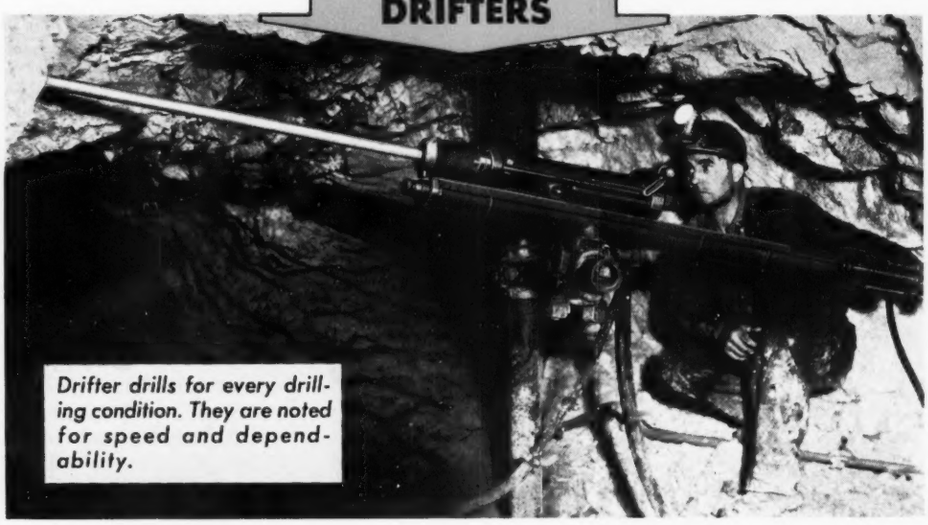

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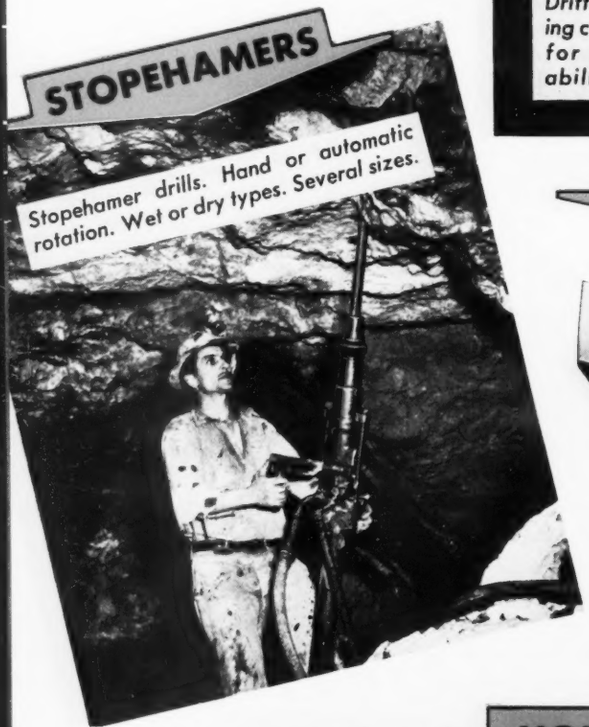

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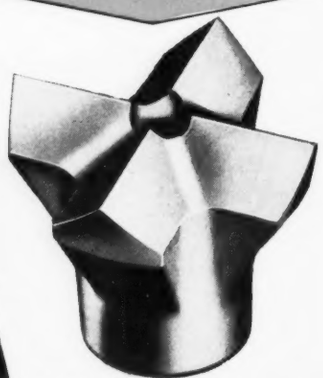

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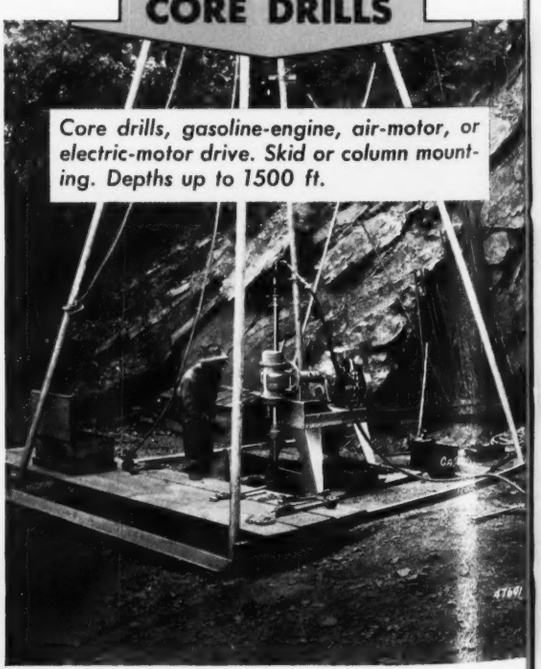

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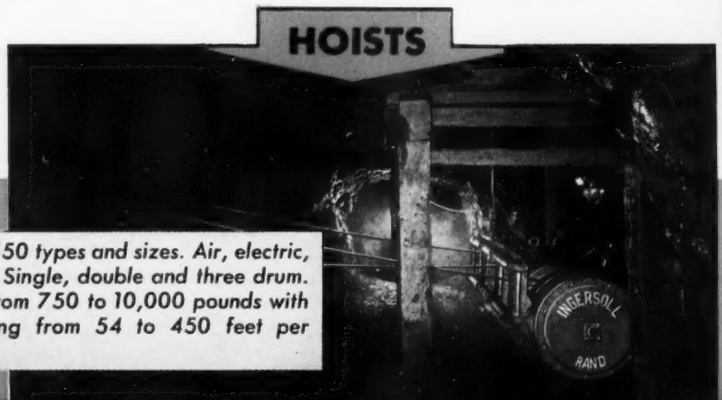

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Regimenting the Bureau of Mines

IT BEGINS TO LOOK as though the forced resignation of John W. Finch as director of the Bureau of Mines was only a step in Secretary Ickes' plan to control the Bureau, and man it with officials who will do his personal bidding. All of which might be defensible if the Secretary were friendly to the mining industry, or if his autocratic methods were less suggestive of the German Gestapo or the Russian OGPU. Reports indicate that he has his own espionage system in the Department of the Interior; that he hails hapless employees of all ranks before him and acts as accuser, prosecutor, judge, jury, and executioner. It was thus that he reportedly dealt with Joseph H. Hedges, assistant to the director, whom he arbitrarily demoted to a minor position at half the salary. In Russia men fight in vain for their lives; in the Bureau for their reputations.

Why was Dr. Finch's resignation forced? Because, although he was Mr. Ickes' appointee, he reportedly could not see eye to eye with the Secretary on the latter's scheme to get regulatory control of the oil industry under the guise of "conservation"; or on the proposed Federal inspection of coal mines (probably later to be extended to metal mines); or on the Secretary's desire to use for other than confidential statistical purposes the Bureau's private reports from mining companies. In short, Mr. Ickes apparently wanted the Bureau to rubberstamp his personal policies. But Bureau officials were too stiff-necked in their refusal to lend themselves to schemes and proposals that are foreign to the work of a fact-finding agency. So the Secretary cracked down and wreaked his vengeance on individuals who stood in the way of using a technical bureau for political purposes and social reform.

Whatever internal dissension there may have been in the Bureau, which the Secretary publicized as the reason for the director's dismissal, it must have been a minor matter compared with the crime of obstructing the Secretary's pet policies. These matters have already been reported in the Washington news in our January and February numbers.

What will Mr. Ickes do next? It is even rumored that he would complete the wreckage of the Bureau by dismembering it and distributing its parts here and there. Nor is that rumor any more fantastic than some earlier ones that have since been verified. In our judgment he has made the post of director unattractive to competent men of integrity. No matter how gayly he dangles a camouflaged noose before the mining profession, few if any of its members will voluntarily stick their heads in it. One already has declined the honor, possibly realizing that the man who takes the job must serve this master blindly or get out. For Mr. Ickes is reported to have said that he has only a few more months to serve in his present office, and is determined to leave his imprint on the Bureau of Mines. Which reminds us that Dr. Finch is the second director of the Bureau to be removed by the Secretary.

Perhaps it is significant of his own lack of assurance in his course that Mr. Ickes had not at the end of February announced a director. He has merely designated acting officials. With shrewd political insight he may sense an impending Congressional investigation of his office, if and when he formally proposes a candidate for director of the Bureau. When that happens, smoldering resentment on Capitol Hill might easily be fanned into a blaze of action. And it would be supported by mining organizations that have already expressed their contempt for the Secretary's methods.

Meantime, the situation will bear watching. Mr. Ickes bodes no good for the mining industry.

T.N.E.C. to Close Inquiry

ANNOUNCEMENT that the Temporary National Economic Committee expects to finish its study of American business and industry by early summer, recalls the diverse reputations the Committee has enjoyed, or suffered, since it began hearings late in 1938. Originally dubbed an anti-monopoly committee, hostile to business, its inquiries were frequently referred to as grills, inquisitions, and witch hunts. And doubtless there were those who would not have been averse to an investigation of that character. But as the hearings of various groups have proceeded, one has heard less of such comment.

In holding the Committee to its course of a fair inquiry into American economy—how and why it functions as it does—none has been more assiduous than the chairman, Senator Joseph C. O'Mahoney, of Wyoming. We recall that in 1938, before hearings had begun, Senator O'Mahoney outlined to a group of business paper editors his conception of the Committee's job—not only what it was, but also what it was not. And during the copper hearings, which were conducted in a friendly atmosphere, the chairman interposed at one point to re-state the Committee's objectives, emphasizing the sincerity of its desire to study the way in which the copper industry functions and disclaiming any intent of putting it "on the grill."

The T.N.E.C. has undertaken a huge task, not only in studying American economy, but also in making numerous special studies and reports on economic subjects. It expects to begin making special reports to Congress this month. The final report cannot be completed before November.

Public Relations via Radio

WITHIN THE PAST FEW YEARS numerous industrial companies have adopted the practice of issuing annual reports to employees. These reports are not formal balance sheet and profit-and-loss statements that are frequently unintelligible to the average employee, but a simple, straightforward, easily understood story of the company's operations.

Last month a novel variation of this practice was instituted by Caterpillar Tractor Company. Sitting at a microphone in a local radio studio at Peoria, Ill., Caterpillar's president broadcast the story of the company's 1939 business. He reached not only the employees, who had just received a printed copy of the report, but the local area in which the company is an important economic factor. For half an hour he enlightened the whole community on details of the company's business—sales, employment, average annual earnings for workers, service to customers, and other pertinent items. We commend the idea of company reports to employees as a means of creating good industrial relations. As far as we are aware, no mining company has yet adopted the plan.

Modern Pioneers

SPONSORED by the National Association of Manufacturers in observance of the one hundred and fiftieth anniversary of the founding of the United States patent system, fourteen meetings, in as many industrial centers from coast to coast, were held during the month of February to honor outstanding inventors and research scientists who have been pioneers on the American frontiers of industry. A major purpose of the whole program was to dramatize in convincing manner the benefits inevitably flowing to any society that encourages individual initiative and maintains the spirit of free enterprise.

The results justified the tremendous effort. An able committee of seven judges headed by Dr. Karl T. Compton, president, Massachusetts Institute of Technology, reviewed 1,026 nominations for recognition as Modern Pioneers. From them they selected 572 to receive awards, including nineteen who were specially designated National Modern Pioneers. The mining and metallurgical industries were well represented in the committee's selections by engineers in manufacturing concerns and in private professional practice, whose inventive genius has contributed to progress in the mineral industries. Conspicuous in the group of nineteen were John V. N. Dorr and Frederick G. Cottrell.

Without the American patent system, however, there would have been less incentive for these inquisitive modern pioneers to formulate and apply their ideas. Despite such defects as it may possess, and which may call for remedy, the system has stimulated invention resulting in the creation of new industries, new jobs, new comforts of living.

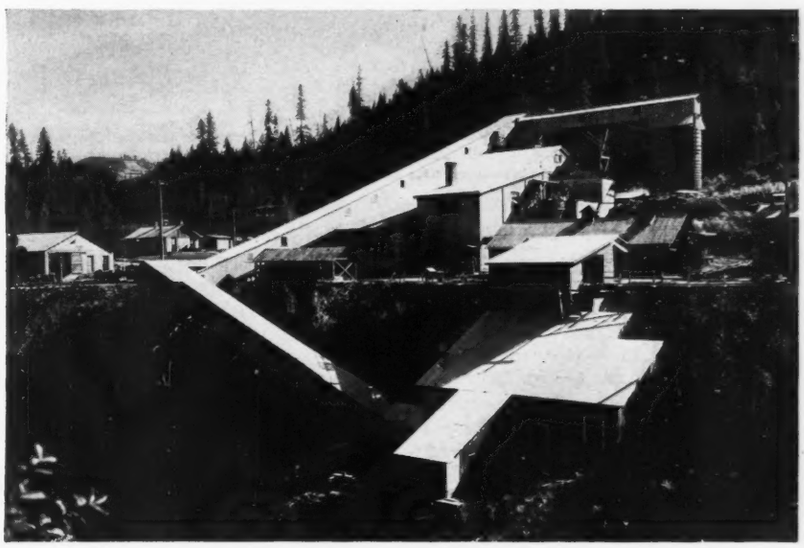
The day of geographical frontiers has gone; but frontiers of knowledge will remain until the human mind has penetrated the last borderline between the known and the unknown in order to satisfy the last unfilled want of mankind. All of which points to limitless opportunities for future development if personal initiative and free enterprise are not curbed. Modern Pioneers are a symbol of a system that offers incentive to human achievement, which ought to be guarded jealously against encroachment.

De-leading Zinc Concentrates At the Pend Oreille Mill

Net returns above operating costs were increased 10 cents per ton concentrated for October, 1939. Changes in ratio of two metals in the feed affect results

C. A. R. Lambly
General Superintendent
Pend Oreille Mines & Metals Company
Metaline Falls, Wash.

Frank R. Milliken
Chief Metallurgist
General Engineering Company
Salt Lake City, Utah



Flotation plant of Pend Oreille Mines & Metals Company, near Metaline Falls, Wash. At present it is treating 750 to 850 tons of ore per day

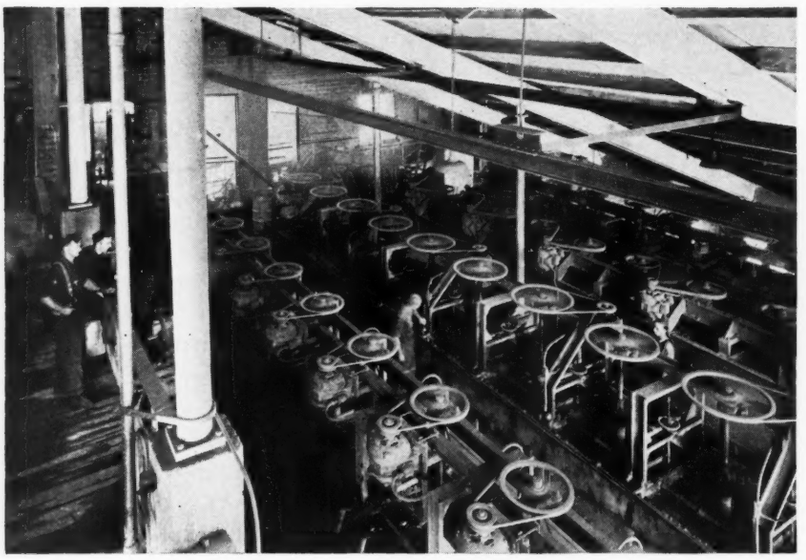
AN UNUSUAL ADDITION to the standard procedure in floating lead-zinc ores has been adopted at the concentrator of the Pend Oreille Mines & Metals Company to improve the separation of the lead from the zinc. By means of it, lead recovery has been increased from 92-94 per cent to 99 per cent, with only a slight reduction in the grade of the lead concentrates, and the grade of the zinc concentrates has been increased 1.5 to 2.5 per cent (from 62 to 64 per cent on an average), with a loss of only 0.4 per cent of the total zinc.

The Pend Oreille mill, situated at the mine about 4 miles from Metaline Falls, Wash., is now treating 750 to 850 tons per day of lead-zinc ore. In its metallurgical characteristics, this ore more nearly resembles the Joplin ores than the complex lead-zinc types usual in the Western States. Liberation of galena and sphalerite from each other and from the quartz-dolomite gangue is substantially complete at the 48-mesh grinding used in the plant. The galena and sphalerite minerals are very pure; lead concentrate shipments have run as high as 83 per cent lead, and zinc concentrate shipments up to 65 per cent zinc. The amount of pyrite is increasing at present, the reason being that a newly developed orebody has a relatively high content of this mineral, but the heads as yet assay only 0.6 per cent iron.

Up to the new unit, the flowsheet of the plant follows standard lead-zinc practice (Fig. 1) more or less. Crushing is done in two stages, the second in closed circuit with a ½-in. screen. Crushed ore is stored in two 600-ton circular bins, each feeding a ball mill. Grinding is done to 48 to 55 per cent minus 200 mesh, depending on the dissemination of the zinc. Flotation of the lead is accomplished in two 10-cell Union Iron Works flotation machines using only Aerofloat 31 as a collector (added to the ball mills). No reagents for depressing the zinc are needed. Lead tailings are conditioned with copper sulphate, then floated in two 12-cell Denver machines and three 10-ft. Southwestern cleaners. Pine oil and ethyl xanthate are used in the zinc circuit except when the feed is high in pyrite, in which case the ethyl xanthate is replaced by sodium Aerofloat. Lead-rougher concentrates are double-cleaned and the zinc-rougher concentrates triple-cleaned. Tailings from the primary zinc cleaner are fed to an 8-ft. cone classifier. The classifier sands are reground in closed circuit with the classifier, the overflow being returned to the zinc conditioner. Final concentrates are filtered in disk-type filters.

Metallurgical results obtained under such operating conditions would be considered more than satisfactory in most cases. For the month of October, 1939, they are shown in Table I. A recovery of 92.1 per cent of the lead in an 81.8 per cent lead concentrate and a recovery of 91.6 per cent of the zinc in a 62.3 per cent concentrate were obtained from heads assaying 1.65 per cent lead and 4.46 per cent zinc. The zinc concentrate from the regular operation, however, assayed 2 per cent lead and contained 7.9 per cent of the lead in the ore. This lead in the zinc concentrate represented a threefold economic loss: (1) with respect to the value of the lead itself; (2) with respect to the payment of treatment and freight charges on this lead under the zinc smelting contract (which charges are relatively high); and (3) with respect to a direct penalty imposed under the zinc-smelting contract. Under this contract, lead above 1.5 per cent is penalized.

Some time previously, the alert management had initiated work to reduce this economic loss. Metallurgical testing was conducted at the property by F. R. Milliken, assisted by members of the Pend Oreille staff. After this



Flotation of the lead is accomplished in two 10-cell U.I.W. machines, the tailings being then treated for zinc in two 12-cell Denver machines and three 10-ft. Southwestern cleaners. De-leading of the zinc concentrates is done in a 6-cell Weinig flotation machine

had indicated that a satisfactory solution to the problem was possible, C. A. Fager, the mill superintendent, designed, constructed, and installed the additional plant required, and it was put in operation. (One important change, to be commented on later, had to be made before operating results approached those obtained in the laboratory). Preliminary tests showed:

1. The lead not recovered in the lead circuit but which floated in the zinc circuit was fine, free galena which floated very slowly. A screen analysis of the zinc concentrate normally produced is shown in Table V.

2. This lead could not be recovered in the lead circuit by increasing the flotation time or conditioning time, or by reagent manipulation. Some benefit might be gained by employing unit cells or gravity concentration in the grinding circuit (recovering the lead before sliming takes place), but it would be small compared with that obtained by the recommended method.

3. The lead could not be depressed economically in the zinc rougher circuit or by a re-treatment of the zinc concentrate, floating off the zinc.

4. Satisfactory results were obtained by re-treating the final zinc concentrate, depressing the zinc with cyanide and floating off the lead.

The last-mentioned method offered such promise that it was thoroughly investigated and a treatment procedure devised. In testing it was noticed that reasonable amounts of cyanide depressed the zinc effectively, but the residual frother made control of the circuit unpredictable. Thorough washing by counter-current decantation or filtration did not help in reducing this frothing. Even after a dozen washings all the original frothing characteristics of the pulp were present. It was found, however, that if about half of the total cyanide necessary for depressing the zinc were added before dewatering, the repulped material, at reasonable dilution (20 per cent solids), exhibited no excessive frothing, and that, upon addition of the remaining cyanide, excellent depression of the zinc in a well-controlled circuit was effected. Approximately the same results with respect to control and metallurgy could be obtained by diluting the zinc concentrate to 3 per cent solids and using sufficient cyanide to give a solution concentration approximately the same as when floating at 20 per cent solids, but under these conditions the amount of cyanide and the flotation capacity required were beyond reasonable limits.

In the initial installation, cyanide was to be added to the zinc concentrate as produced in the regular mill operation, then dilution water to give a pulp of 10 per cent solids, and the pulp then thickened to 50 per cent solids, thus removing 89 per cent of the original water from the zinc concentrate. It was found impossible, however, to hold the thickener at this density because of irregularities in the feed and the coarseness of the solids in the thickened pulp. At times, the thickener underflow would thin down to 25 or 30 per cent solids, with consequent over-frothing of the subsequent flotation circuit. The washing thickener step as a consequence was replaced by filtration. Filtration gave a positive removal of 93 per cent of the original zinc concentrate water; and control of the circuit under these conditions became absolute. The present flowsheet of the "de-leading unit" is shown in Fig. 2.

The following operating conditions deserve mention:

1. Cyanide—In laboratory tests, 3 lb. of cyanide per ton of zinc concentrate treated was required for satisfactory depression of the zinc. This amount was split about evenly between the dewatering step and flotation. In practice, however, over a two-months' period, the cyanide used has averaged 4 to 5 lb. per ton of concentrate treated

Table I—Mill Operation Without De-leading

Product	Per Cent Weight	Assay		Per Cent of Total Metal	
		Pb %	Zn %	Pb %	Zn %
Lead concentrates	1.86	81.82	0.38	92.1	0.2
Zinc concentrates	6.56	2.00	62.27	7.9	91.6
Zinc tailings	91.58	.....	0.40	.....	8.2
Heads	100.00	1.65	4.46	100.0	100.0

Table II—Mill Operation With De-leading

Lead concentrates	1.86	81.82	0.38	92.1	0.2
De-leading concentrates	0.19	60.00	9.53	6.8	0.4
De-leading zinc	6.37	0.31	63.81	1.1	91.2
Zinc tailings	91.58	.....	0.40	.....	8.2
Heads	100.00	1.65	4.46	100.0	100.0

Table III—Mill Operation With De-leading

Total lead concentrates	2.05	80.00	1.27	98.9	0.6
De-leading zinc	6.37	0.31	63.81	1.1	91.2
Zinc tailings	91.58	.....	0.40	.....	8.2
Heads	100.00	1.65	4.46	100.0	100.0

Table IV—De-leading Unit Operation

De-leading concentrates	2.83	60.00	9.53	85.0	0.4
De-leading zinc	97.17	0.31	63.81	15.0	99.6
Regular zinc concentrates	100.00	2.00	62.26	100.0	100.0

Table V—Screen Analysis of Regular Zinc Concentrate Production

Product	Per Cent Weight	Assay, % Lead	Per Cent of the Lead in Zinc Concentrate
+ 200 mesh	36	0.14	2.4
− 200 mesh sand	38	1.08	19.8
− 200 mesh slime	26	6.18	77.8
Total zinc concentrate	100	2.07	100.0

(0.3 lb. per ton of original ore). This excess is maintained by the operators to take care of sudden fluctuations in the feed to the circuit. Addition of cyanide is regulated by the quantity of dilution water added. This water is added in two places—namely (1) at the repulper on the cake from the dewatering filter, and (2) to the flotation feed. Dilution water sufficient to give 25 and 16 per cent solids at these points respectively is used. If these densities are maintained, the dilution water used is directly proportional to the tonnage treated, and the quantity of such water can be used by the operator as a guide in regulating the cyanide addition.

2. Density—It is necessary that the flotation feed be maintained below a critical density of 22 per cent solids. If the pulp becomes thicker than that, excessive frothing results. The 6x6-ft. conditioner evens out surges in the feed, so that hourly density determinations are sufficient for the operator to maintain the correct percentage of solids in the flotation feed.

3. Flotation—This is accomplished in a 6-cell Weinig 30-in. flotation machine, using the first cell as a single-stage cleaner. No reagents except the cyanide are necessary. As stated, froth control is accomplished through dilution. No collector is needed for the lead; it floats readily, giving a very black froth having rather large bubbles. The machine is operated to produce a high-grade lead concentrate rather than to obtain the ultimate recovery of lead. The tailings from the operation constitute the final zinc concentrates. As they leave the flotation machine, they are in a dispersed condition and must be flocced for thickening and filtering. Ordinary flocculating agents had little effect, so copper sulphate was used. The zinc is not actually reactivated but it does form large flocs, promoting good thickening and filtering characteristics. The lead concentrate produced is added to the regular lead concentrate production for filtering.

Metallurgical results obtained in the de-leading unit for October, 1939, are shown in Table IV. The change in the over-all mill results due to the de-leading operation may be seen by comparing Tables II and III with Table I. About 85 per cent of the lead in the zinc concentrate is recovered in a 60 per cent lead concentrate while rejecting 99.6 per cent of the zinc. Peculiarly enough, in the presence of this large amount of cyanide, a good portion of the pyrite in the zinc concentrate also floats with the lead, further increasing the grade of the de-leaded zinc. For the month of October, the lead recovery was increased 6.8 per cent (concentrate grade decreased from 81.8 to 80.00 per cent lead) and the zinc grade was increased from 62.3 to 63.8 per cent zinc (zinc recovery decreased from 91.6 to 91.2 per cent).

Although the benefits from de-leading appear small, for the month of October the increase in return from sale of products due to the de-leading was $0.16 per ton of ore milled. Of this amount, return from the sale of lead concentrates was increased $0.07 per ton (because of greater recovery even though lower grade) and the return from sale of zinc concentrates was increased $0.09 per ton of ore milled (due to higher grade even though lower recovery). The cost of the operation, including chemicals, power, depreciation, and others, was estimated at $0.06 per ton of ore milled. The de-leading operation, therefore, increased net returns above operating costs $0.10 per ton of ore milled—an important amount in view of the 250,000 tons treated annually. Per ton of zinc concentrate treated, the returns were $2.40 and operating costs $1.00, a profit of $1.40 per ton of concentrate treated.

Changes in ratio of lead to zinc in the mill feed affect materially the economic value of the de-leading opera-

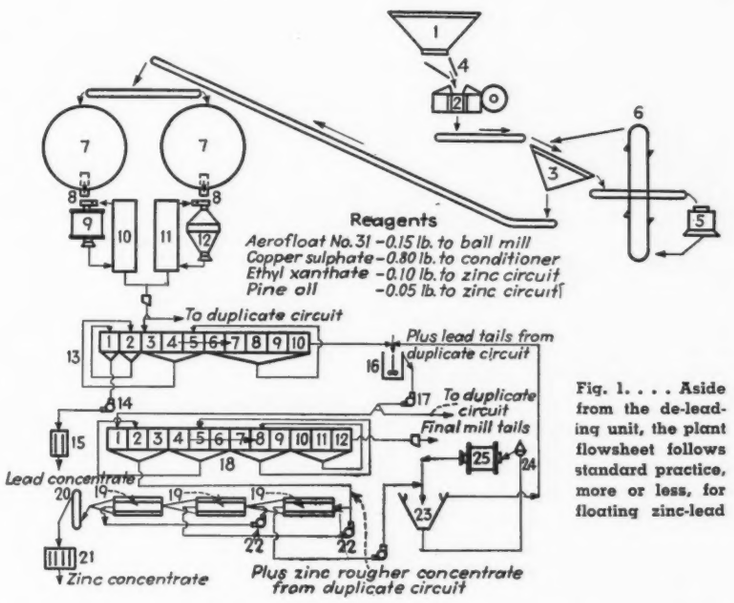

Reagents
Aerofloat No. 31 - 0.15 lb. to ball mill
Copper sulphate - 0.80 lb. to conditioner
Ethyl xanthate - 0.10 lb. to zinc circuit
Pine oil - 0.05 lb. to zinc circuit
To duplicate circuit
Plus lead tails from duplicate circuit
To duplicate circuit
Final mill tails
Lead concentrate
Zinc concentrate
Plus zinc rougher concentrate from duplicate circuit

Fig. 1. . . . Aside from the de-leading unit, the plant flowsheet follows standard practice, more or less, for floating zinc-lead

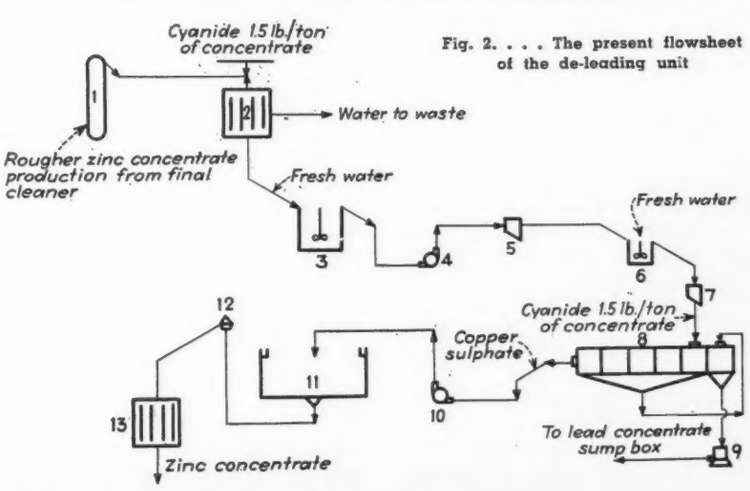


Fig. 2. . . . The present flowsheet of the de-leading unit

FIG. 1—LEGEND

1. Coarse-ore bin, 200 ton
2. 15x36-in. Traylor jaw crusher
3. 4x8-ft. A.C. ⅞-½-in. screen
4. Ross feeder
5. 4-ft. Symons crusher
6. Elevator
7. Two 600-ton fine-ore bins
8. Mill feeder
9. 7x6-ft. Allis-Chalmers grinding mill
10. 7x16-ft. Hardinge classifier
11. 60-in. Akins classifier
12. 8-ft. by 48-in. Hardinge mill
13. Two 10-cell U.I.W. flotation machines
14. 1½-in. Denver vertical pump
15. 2-disk American filter
16. 10x10-ft. conditioner
17. 4-in. Wilfley pump
18. Two 12-cell Denver flotation machines
19. Three 10-ft. S.W. flotation machines
20. Bucket elevator
21. 4-disk American filter
22. Three 2-in. U.I.W. pumps
23. 8-ft. Cone classifier
24. 2-in. Diaphragm pump
25. 4x4-ft. Regrinding mill

FIG. 2—LEGEND

1. Bucket elevator
2. 4-disk American filter
3. 6x6-ft. conditioner
4. 2-in. U.I.W. pump
5. First density control
6. 3x3-ft. mixing tank
7. Second density control
8. 6-cell, 30-in. Weinig flotation machine
9. ¼-in. Denver vertical pump
10. 2-in. U.I.W. pump
11. 20-ft. thickener
12. 3-in. diaphragm pump
13. 4-disc American filter

New Federal Census of Metal Mining Is Now Under Way

First project of its sort in ten years has been started by sending questionnaires to mines and quarries throughout the country

NEW FACTS on the mining industries, of practical value to all persons concerned with their operations, are now being collected as part of the first Census of Mines and Quarries in ten years.

Questionnaires have been sent to producers of copper, lead, zinc, iron, gold, silver, and other mined or quarried commodities. When all individual returns have been received, they will be tabulated, and published in national, state, and industry totals.

Not only will comparable 1939 figures be sought on number of mines, employment, and other basic matters that were covered in previous censuses, but a number of important new queries are included in the schedules.

Of significance both to mining companies and concerns which sell to them will be the answers to one question on costs of buildings, machinery, and equipment erected or installed during 1939; and to another on number of mechanical-power loading machines in use or available, by types. Both of these topics are being thoroughly surveyed.

Loading equipment is to be classified by kind of power used—steam, electric diesel-electric, compressed air, gasoline, or diesel; by dipper or bucket capacity; and by rated horsepower for scraper hoists.

Capital expenditures are to be divided among those for buildings and other structures used in production and related activities, including mills, for example, but not company houses; those for *new* machinery and equipment installed; and those for equipment that was originally purchased in a used condition.

As in 1929, stock will be taken of power equipment in use or available. The number and horsepower rating of both stationary or mobile units are to be reported, the latter group including engines, motors, and similar units used for driving mobile or portable equipment. Total cost of supplies and materials consumed during the year for any purpose in connection with the development or operation of the mine or plant will again be the subject of inquiry.

In collecting figures on value of 1939 production, special effort is being made to arrive at a total which will represent the value actually received by the mining industries for ore, as contrasted with available current statistics on values that generally represent the selling prices of metal.

The important rôle the mining industry plays in providing employment and workers' income will be delineated by facts to be gathered on employment and payroll. In addition to reporting the number and annual earnings of production workers and of supervisory and clerical help, mining companies have been asked to supply figures on number of wage earners by months. Data are also sought on employment by departments.

Similar inquiries are being put to companies doing contract work for the mining industry.

Reporting to the Census Bureau is required by law, but the same statute protects those giving the answers against disclosure of individual returns, or their use for taxation, investigation, or regulation. Their sole purpose is for the preparation of statistical totals.

Preliminary summaries of the basic facts will be published by late summer or early fall, with special trade reports following as rapidly as possible. Prompt returns from all mining companies will facilitate early publication of statistics on their industry.

▼ ▼ ▼

Cost of Detachable Bits at Carlton Tunnel

PROGRESS in driving the Carlton tunnel for deeper drainage of the Cripple Creek district, Colorado, was reported in *E. & M. J.*, December, 1939. Recent information released by A. H. Bebee, vice-president in charge of mining operations for the Golden Cycle Corporation, gives details on drilling with Timken rock bits which superseded conventional steel about Oct. 1, 1939, three months after starting the tunnel.

Though conventional steel was used, eight blacksmiths and two Ingersoll-Rand drill sharpeners were required in the shop, and six nippers on the jumbo. Fuel-oil consumption was 7,600 gal. per month, at 11½¢ per gallon. Power demand reached 500 hp. After the adoption of detachable bits, the number of blacksmiths was reduced to an average of three and one-half, nippers to three, and fuel-oil consumption to 600 gal. per month. One Masseo bit grinder was installed. Power demand was 500 hp. The number of drilling rounds was increased from a maximum of nine to a maximum of eleven.

In the shop two men are steadily employed sharpening bits, and the others for shanking, upsetting, threading, and tempering steel. Two and one-eighth inch center-hole bits, used as starters, are ground down to smaller sizes to complete the cycle. No retempering is done, as a high percentage of the bits reaches the discard size of dulled $1\frac{9}{16}$-in. before much softness is observed. About six re-grinds are obtained. Bits are ground after every 2-ft. run to a slightly rounded wing point without regard to size. They are then sorted to the nearest $\frac{1}{16}$-in. gage and made up in sets having $\frac{1}{8}$-in. difference. Hollow round $1\frac{1}{4}$-in. steel is threaded with H-threads at the rate of twelve per hour.

In November, 1939, the total number of bits ground was 23,474, using 11 K-faced wheels ($12.65 each) and 5 A-faced wheels ($13.60 each). Costs were as follows:

	Total	Per bit
Labor	$357.00	$0.0152
Wheels	207.15	0.0088
Grinding cost	564.15	0.0240

Cost per "bit use" was about 5.63c., based on new bit cost of 25c., six re-grinds at 2.4c. each, and seven uses for each bit. These figures are exclusive of power for the grinder (about 12c. per 8-hour shift) maintenance, depreciation, oil, wheel dressers, and other minor items.

De-leading Zinc Concentrates

(*Continued from page* 31)

tion. At times, with low-lead, high-zinc feed the cost of the operation exceeds increased returns, and the de-leading unit is shut down. At other times, with high-lead, low-zinc feed the de-leading is essential. When the lead in the zinc concentrate reaches 4 per cent, the increased return by de-leading will amount to $5 per ton of zinc concentrate.

Acknowledgment is made to Lewis P. Larsen, president of the Pend Oreille Mines & Metals Company, for permission to publish this material. C. A. Fager, mill superintendent at Pend Oreille, was invaluable in the design, construction, and operation of the unit. J. Crampton, chief chemist, was of material assistance throughout the testing and initial operation.

An Operating Man Visualizes
TOMORROW'S MINING METHODS

Mechanization to a high degree is to be expected, using equipment and materials now available

Mark A. Smith
Kimberly, Nev.

▶ THIS DISCOURSE *on Tomorrow's Mining Methods is based on the utilization of all applicable equipment, data, and technical skill existing in the various industries and schools today. Technological advances will continue unabated in all fields, but it is futile to speculate on the obscure and distant future until all available tools are first put to use.*

TOMORROW'S mining methods will be highly mechanized. Unprecedented progress in underground mining practices will be brought about by mechanization. Perhaps the most radical changes will be in conveying, though far-reaching changes will also take place in exploratory drilling, excavating, undercutting, drawing, and loading.

For discussing mechanized mining the classifications of mining methods in use at present are inadequate. The terms usually define specific phases of mining. *Cut-and-fill,* for instance, describes a manner of stoping and of supporting by filling. *Branch-raise caving* defines a manner of stoping, and a manner of conveying ore by gravity through branch raises. In a broad sense, however, mining is not completed until the ore is delivered to the surface. Yet practically all classifications disregard transportation, which is a major—and often the major—cost item in mining.

The basic operations of mining are breaking and transporting ore. By separating these operations into their simplest elements they can be critically examined and appraised. There are as many variations and combinations in the breaking and transporting methods as there are variations in orebodies, but employment of the appropriate means will result in the most economical method. The term *stoping* (from Middle English *step,* meaning extraction of ore by steps) is unsatisfactory because it combines the operation of breaking and transporting—although the line of demarcation is not always sharp. For example, material is made to run directly into raises or slides when broken by picking or blasting. Breaking and transporting, nevertheless, are distinct functions, and it is desirable that they be recognized as such. The three fundamental methods of breaking ore or other materials are, (a) by drilling and blasting, (b) by mechanical or manual excavation, and (c) by caving. The transportation of ore from the stope face to the surface may be regarded as one function requiring two or more stages. The streamlined methods of tomorrow, under ordinary conditions, will convey ore (a) by gravitational or mechanical conveyance from the stope face to the *mining* or stope conveyors, (b) by mining or stope conveyors to the *trunk* conveyor, and (c) by trunk conveyor to the surface.

All systems of mining, present and proposed, fall logically into the expanded functional classification.

Tomorrow's Cave Mining—Improvements in all mining methods will be rapid and widespread when the benefits to be gained from mechanization are understood. This paper sketchily covers a specific method, *Tomorrow's Cave Mining.*

A prerequisite for visualization of tomorrow's mining is an appreciation of the fact that the primary function of the labyrinthic branch-raise and drift system common to undercut caving is transportation, though this fact may be hidden in an empirical haze. The drifts and raises are driven and maintained for one purpose—to extract ore. These openings at the same time provide the necessary ways of ingress and egress for miners to drive and maintain drifts and transport ore. There are three progressive transportation stages in conventional branch-raise caving: transfer of ore from the draw points to the haulage level through branch-raises, thence by motor haulage to the pocket, thence by hoisting from the pockets to surface. Substantiation of the statement that cave mining is predominantly transportation is found in the accompanying interpretation of cost analyses, in the table on page 36.

Tomorrow's principal medium of transportation will be mechanical conveyors. The type of conveyor—slusher, shaker, chain, or belt—will depend upon the particular conditions and requirements. By replacing motor haulage and gravity methods they will revolutionize cave-mining practices and change the concept of caving mechanics. As a result of these improvements the costs for the average thickness of ore mined today will be reduced to 25 or 30c. per ton—less than half the present average costs. By the use of conveyors preparatory work will be reduced to a third of that required for the multiple branch-raise method, and will make it practicable to draw large areas rapidly and uniformly and to measure accurately the ore drawn from each point. This will effect a high recovery of ore with negligible waste dilution, an advantage which is of great economic importance.

These analyses, which I do not expect to go unchallenged, are the result of an intensive study of the subject. Recent developments in underground mechanization corroborate the statements made in the foregoing.

Present Underground Transportation Unsatisfactory—Today's conveyance practice in porphyry mines is, with the minor exception of slushing and the entirely unsatisfactory exception of hand-tramming, confined to hoisting, motor haulage, and gravity methods. (Fig. 1). Motor haulage is by necessity horizontal. The inclination of the branch-raises depend on the physical character and the moisture content of the ore and will vary from 55 to 75 deg. from the horizontal.

This wide gap between the interdependent motor haulage and gravity system makes these conveyance mediums unsuitable for cave mining from both the point of costs and of ore recovery, as is disclosed by a study of the size and shape of porphyry orebodies. The ore bottoms dip at varying inclinations, and locally may be flat or very steep, undulated, folded, or step-faulted, but as a whole there is a marked uniformity of dip. A study of bottom contours of the porphyry orebodies shows a mean dip of about 20 deg. from the horizontal—an angle less than halfway between that of the motor haulage and gravity method.

Tomorrow's Conveyance Methods—In tomorrow's mining the conveyor drifts and fingers will be the only extraction openings required for mining.

All preparatory work of the conventional multiple-raise, motor-haulage, hoisting system, which entails duplicate levels, stations, pockets, and haulage equipment, will be entirely eliminated. In addition to the economies that will result from minimization of development work, the conveyor methods will make it possible to recover a higher percentage of footwall ore than is possible with the conventional methods.

Before continuing with this discussion it is desirable to define terms, so as to avoid confusion. To my knowledge there are no common terms for mechanically conveying ore up or down steep grades. Inclined conveyance will refer to either up- or down-grade conveyance, and *anaclinal*[1] conveyance will be used to denote up-grade conveyance and *cataclinal*[2] conveyance to denote down-grade conveyance.

The term transportation as broadly used here includes conveyance in all planes—horizontal, vertical, and inclined—and by all methods—manual, gravity, and mechanical. It includes transportation of ore from the undercut horizon through the draw points to raises, cars, or conveyors.

[1] Anaclinal streams are streams that flow up the dip of strata. [2] Cataclinal streams are streams that flow down the dip of strata. Consequently, I believe that these terms would be useful to denote conveying streams of ore up-grade or down-grade.

Inclined conveyance machinery is not manufactured today that will transport ore on inclinations exceeding 25 deg. from the horizontal with the exception of slushers and chain or flight conveyors which are limited in capacity and distance. Obviously, cataclinal conveyance is simpler and more economical than anaclinal conveyance, as the flow of material is aided by gravity. The manufacturers are ready to develop suitable inclined conveyance machinery when the mining industry presents its transportation problems.

Mining by Conveyors—Tomorrow's mining methods will incorporate two principal conveyor systems, the *trunk* conveyor, and the *mining* conveyor. (Fig. 3). In slightly more complex methods branch conveyors will deliver ore from the mining conveyor to the trunk conveyor. Inasmuch as space does not permit details, only the fundamentals of the simplest case will be described here.

The trunk system will convey ore or other material from the lowest and furthermost part of the mine to the surface in one stage. The trunk conveyor has two functions—gathering and conveying. In this system the gathering portion of the trunk system will skirt the lower, outer fringe of the orebody, and the terminal or conveying portion will ordinarily be inclined, since it will replace the motor haulage and hoisting systems. The trunk conveyor drift will be located 20 or 30 ft. below the orebody to protect it from the weight of the caving mass and to provide suitable loading hoppers for the mining conveyors.

The mining conveyor drifts, where branch conveyors are not required, will be perpendicular to the trunk conveyor, and inasmuch as the trunk conveyor fringes the lowest portion of the orebody, the mining drifts will extend up the dip. Ore will load directly on the cataclinal mining conveyors from the fingers or draw points and will discharge into the feeding hoppers, from which it will feed automatically on to the trunk system. When the feeding hopper at the mining drift terminal is filled to a predetermined height, the ore will cut a photo-electric beam causing the mining conveyor to to stop, and to start again when the ore in the feeding hopper is drawn down.

For minimum preparatory work and maximum ore recovery the mining drifts should, so far as practical, follow about ten feet under and parallel the ore bottom. The draw points

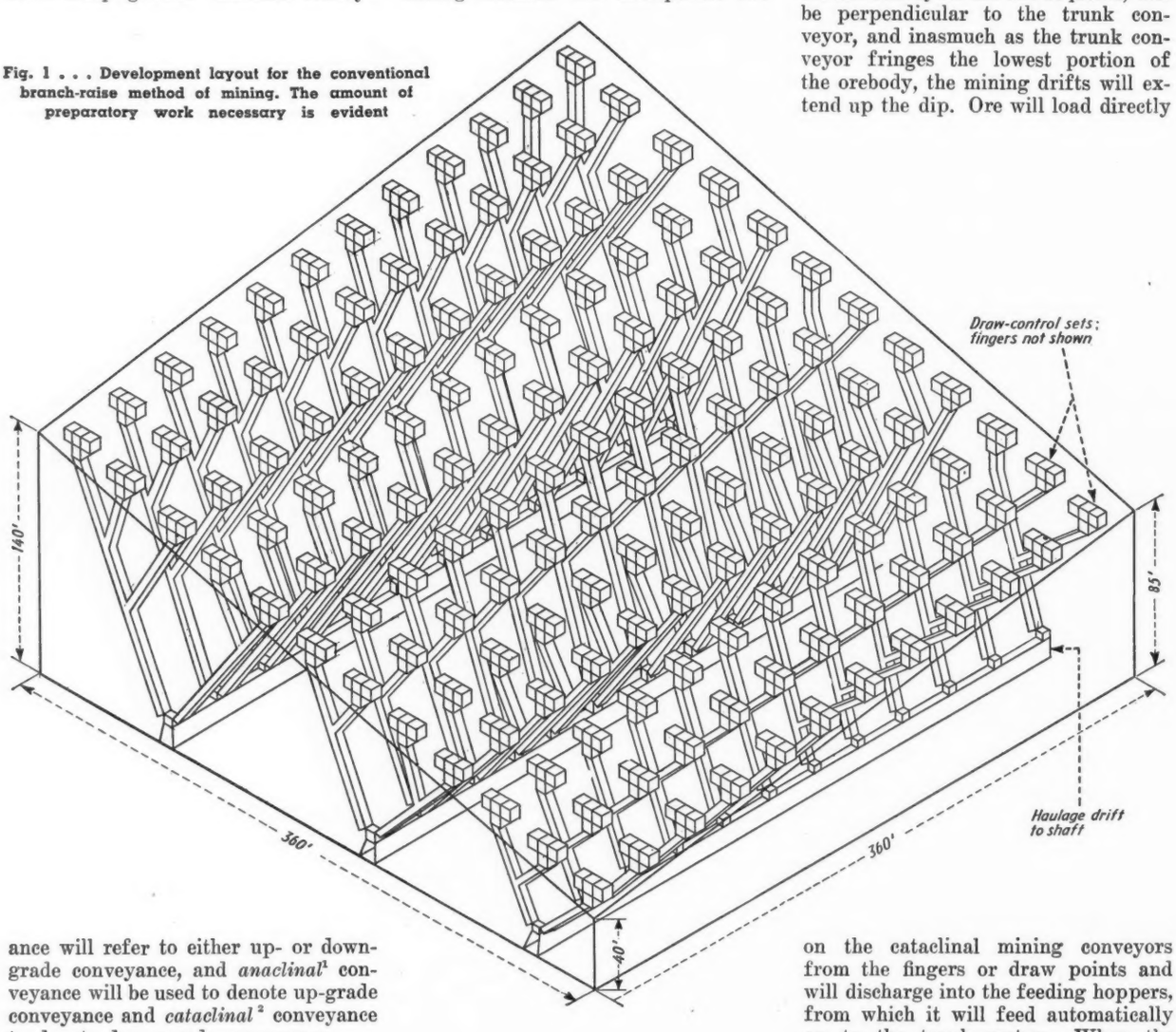


Fig. 1 . . . Development layout for the conventional branch-raise method of mining. The amount of preparatory work necessary is evident

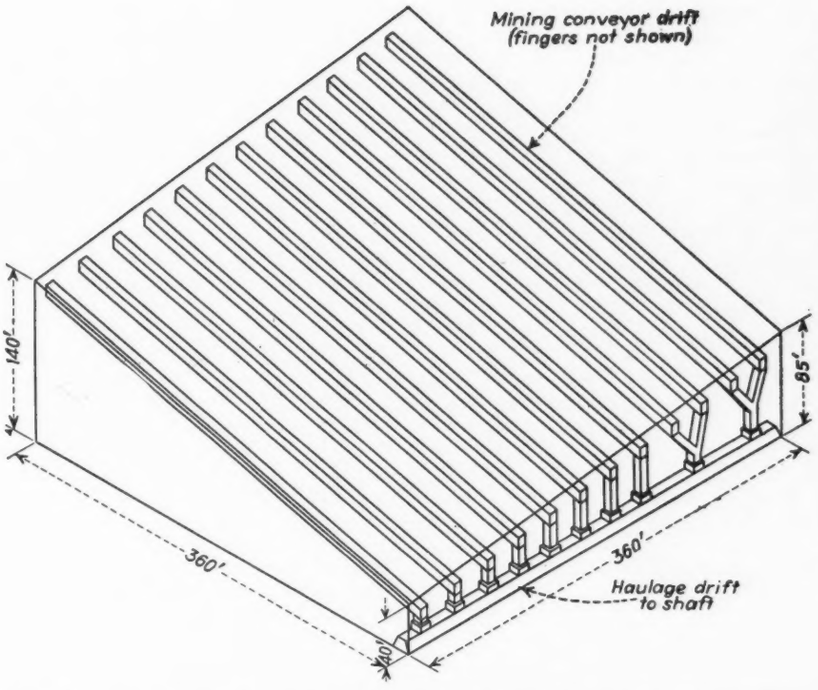


Fig. 2 . . . This depicts a transition stage from the branch-raise method to a more highly mechanized caving method using conveyors extensively

should terminate at the bottom of the ore. The drift centers will be determined by the character of the ore but will be parallel and probably on 25- to 30-ft. centers in average ore. Draw points will be placed at 12½- or 15-ft. intervals along the drift, and will discharge directly on the conveyor. The distance of the drifts below the ore bottom will vary with the character of the footwall and the ore. From drill cores and sludges the characteristics of the ore and footwall, such as compression, shearing strength, and moisture content, will determine the design and position of the drifts.

The cross-sectional area of the conveyor drifts will be small compared to conventional grizzly and haulage drifts, inasmuch as they will usually be circular or oval in shape, a drift design having the smallest volume and greatest strength. The drifts will be timbered where the ground is strong or where, due to thinness of ore, the block life will be short. If the trunk, branch, or mining conveyor drifts pass through weak ground, or if the height of ore justifies, they will be lined with steel or concrete. The conveyor supports will be suspended from the arch or the sides of the drift, leaving the bottom free for drainage, storage of supplies, or clean-up.

It follows that these drifts, which will be built to accommodate conveyors, will be relatively free from interruption of drawing caused by drift maintenance, and that the drawing efficiency will consequently be greatly increased.

The capacity of the mining conveyor will be from 100 to 600 tons per hour for each unit, depending on the speed and the width of the conveyor. For a 300-ton per hour conveyor unit only four or five mining drifts will be required to produce from 8,000 to 10,000 tons per shift. It is easy to visualize four or five mining conveyors loading automatically on to the trunk system with no attention other than routine maintenance of equipment.

The conveyance requirements of cave mining are exacting, because pre-determined tonnages must be drawn from specific points at definite time intervals. These demands are fully and satisfactorily met by the conveyor method. Tomorrow's mining will in all cases utilize the vehicle of conveyance best suited for the particular condition, and cataclinal conveyance will play an increasingly important part in all types of mining.

New Concepts of Cave Mining—With the improvements of Tomorrow's conveyance methods will come a new conception of cave mining and caving mechanics, resulting in rapid, systematic, and economical exploitation of orebodies. Mining, regardless of tonnage produced, will be restricted to one area, replacing the decentralized checkerboard and panel methods in practice today. The full width of the orebody will be mined as a retreating panel. The retreat will be along the strike, and at the same time down the dip from the high- to the low-lying ore. This statement is made at the risk of criticism, but mathematical and graphical analyses show many advantages of this plan over the checkerboard and panel methods. Research done so far in the little understood field of mechanics of caving confirms these conclusions. Perhaps the most obvious if not the most radical change will be the total elimination of all motor haulage drifts and branch-raises. The preparatory work necessary for conveyorized mining is roughly equivalent in volume and costs to the grizzly and connection drifts and control sets required for the branch-raise methods.

Importance of Proper Drawing—The degree of success in cave mining is determined by the degree of success in drawing, the aim being maximum recovery of ore with minimum dilution by waste. Those familiar with this problem agree that control of ore drawing is the most difficult and yet one of the most important operations of cave mining. By the use of photo-electric cells, conveyor-weighing devices, or other means the amount drawn from each point will be accurately measured and recorded.

Mechanics of Caving and Maintenance—Great pressures are exerted on the extraction openings in cave mining. Acting singly or together the pressures are produced either by chemical action or by overlying weight of the rock. Chemical action causes the rock to swell, weight causes it to flow, and the swell or flow is accompanied by spalling and sloughing. These pressures are pronounced in structurally weak ground. Water, acting as a lubricant, facilitates flow in fractured, sheared, and jointed ground. Gravity pressures are greater and more difficult to hold, and are especially active within the caving area. This force, fortunately, is subject to laboratory experiment and mathematical interpretation that leads to useful conclusions.

In weak ground—and most porphyry ores are weak—the pressure on the extraction openings makes constant repairing necessary. Partial failure or collapse is frequent, despite all efforts to keep the drifts and raises open. High maintenance costs follow. In one drift the ground was observed to move two feet in 24 hours. In the efficiently operated Miami Copper mine the repairs of the draw-control sets are equivalent to 100 per cent replacement.[3] This is only the tangible cost. The intangible costs, dilution of ore with waste, and loss of ore, may be equal to the maintenance cost. Some of the repairs can be attributed to lack of uniform drawing, some to slow drawing.

Repair costs will be negligible when the mechanics of ground movement are understood. Most operations to-

[3] "Miami Copper Company Method of Mining Low-grade Orebody." By F. W. Maclennan.

day are based on experience and experiment, not on analysis of the mechanics of rock masses. From cumulative experience the size and shape of the draw area, and the rate and manner of draw are determined. By combining observation, experience, and a knowledge of the engineering properties of soils and rocks, many of the difficult problems of drawing and repairing will be answered. P. B. Bucky, associate professor of mining, School of Mines, Columbia University, among others, is doing important research work in rock physics that will lead to a better understanding of the gravitational forces.

It is highly desirable that the draw area be large enough to force the surface to subside. This prevents waste from running in from the sides or top through cavities or voids that occur when the surface does not subside. It also helps crush the ore in descending, prevents hazardous air blasts, and permits a rapid, dependable flow of ore. Contrary to current opinion, subsidence of the surface does not throw additional weight on the extraction openings. This applies where the horizontal dimensions are small compared to the height of the column. In the following discussion it is assumed that the undercut area is large enough, or that the walls have been weakened, to permit the capping to subside.

Close observation of the caving action shows how the weight on the extraction openings is governed by the rate of drawing. When a finger pipes or stopes we can see into the cave, and by studying the caved mass and the piping action many useful conclusions can be drawn. Assuming the ore is of a character that pipes (though piping is not a necessary condition), the drawing may be followed by arbitrary steps as shown in Fig. 4. In (a) the finger is full or "down." The first step (b) is to empty the finger, when arching commences. In (c) the finger has started to pipe and in (d) it has reached its limit of piping; in (e) the walls and arch start to fail, and in (e) the pipe has failed, refilling the finger. In dry, friable ore there may be no perceptible arching. The ultimate effect is about the same whether the ore pipes or not, excepting that in friable ore the horizontal movement would be somewhat further than in sticky ore. The size of the undercut area (which probably is circular) influenced by drawing of a finger is not definitely known. But for full recovery of ore and minimum weight on the extraction openings the finger areas should merge a short distance above the fingers. In sticky ore the fingers occasionally pipe to the capping. In such circumstances the draw points are spaced too far apart and the ore between the pipes is lost. It is assumed in this discussion that the fingers are properly spaced and that the draw from all the fingers in the entire block coalesces a few feet above the fingers. The entire block will draw in the same manner as a greatly enlarged finger if the ore is drawn rapidly enough.

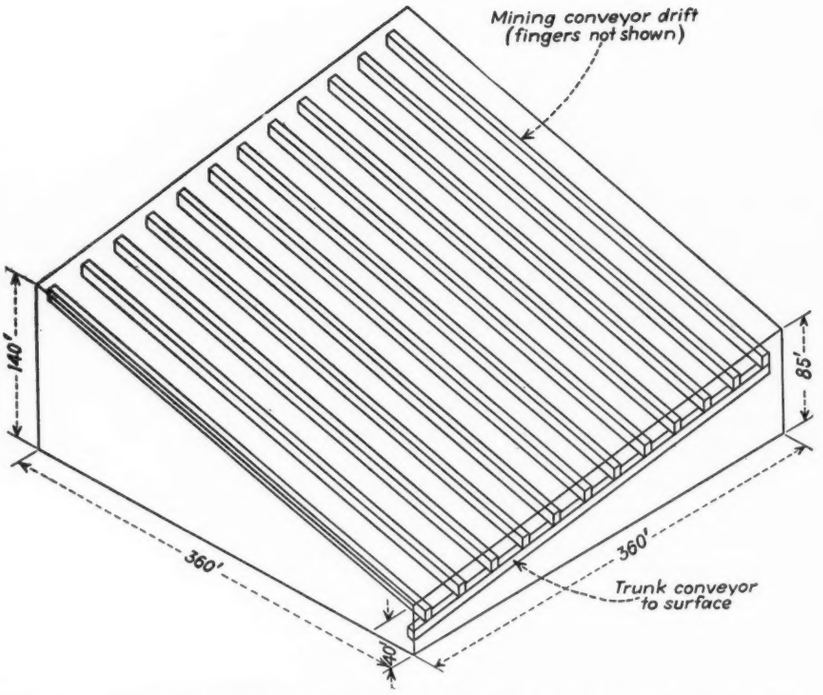


Fig. 3 . . . Development layout for caving method employing conveyors for transport of ore

It is obvious that the ore does not pack solidly immediately after a finger is drawn, and equally obvious that unconsolidated ore cannot transfer weight to the drifts and raises below. From every-day observation in the mine it is seen that when the ore starts to run freely it is not difficult to keep it running, but when the drawing stops the ore starts to consolidate, due to settling and readjustment of the caving mass. The longer a finger goes without being drawn the more difficult it is to start.

The weight of the ore is not removed by fast drawing. It is transferred to the sides of the adjacent areas. This may be explained by conceiving the block to be a conduit 120 ft. square and 600 ft. high, with extremely rough walls, and filled with material having a high coefficient of friction. The descent of the ore is retarded by internal friction, cohesion, arching, and side thrust. Most of the weight of the material in the conduit is transferred to the sides of the adjacent areas. The effect is practically the same as when solid ore domes or arches, often forming voids. This holds whether the side walls are virgin or caved ground, and is confirmed by observation, experiment, and mathematical analysis. A 600-ft. column of ore and capping weighs over 50 tons, a weight that no timbers could support. The absence of such enormous pressures on the drifts can be explained only in the aforementioned manner.

From experience it is known that slow or irregular drawing causes tremendous weight to settle on the drifts and raises. Conversely, rapid and uniform drawing does not give the ore time to consolidate, which minimizes weight. From observation of the caving action, as described in a preceding paragraph, it is seen *why* fast drawing does not permit weight to settle on the drifts and raises. From these studies, in collaboration with laboratory and mathematical analyses,

Interpretation of Cost Analyses Indicating That Cave Mining Is Predominantly Transportation (see page 33)

	Percentage Analyses of Costs of Typical Caving Operations (a)	(b)	Average Per Cent of Cost Item Estimated to Be for Transportation
Development (Labor and supplies)	25.0	24.1	100
Undercutting (Labor and supplies)	8.6	3.6	0
Drawing ore (Stoping)	25.6	30.7	100
Haulage	13.3	15.1	100
Hoisting	8.3	6.0	100
General mine expense	11.4	9.7	90
General mine	7.8	10.8	90
Total	100.0	100.0	
Per cent of total to transportation	89.4	94.1	

(a) An Arizona porphyry mine. (b) A Nevada porphyry mine.

the conclusion is reached that by choosing an area of proper size, and by closely correlating extraction and surface subsidence with rapid and uniform drawing, the drifts and raises can be kept free of most of the weight of the caved mass.

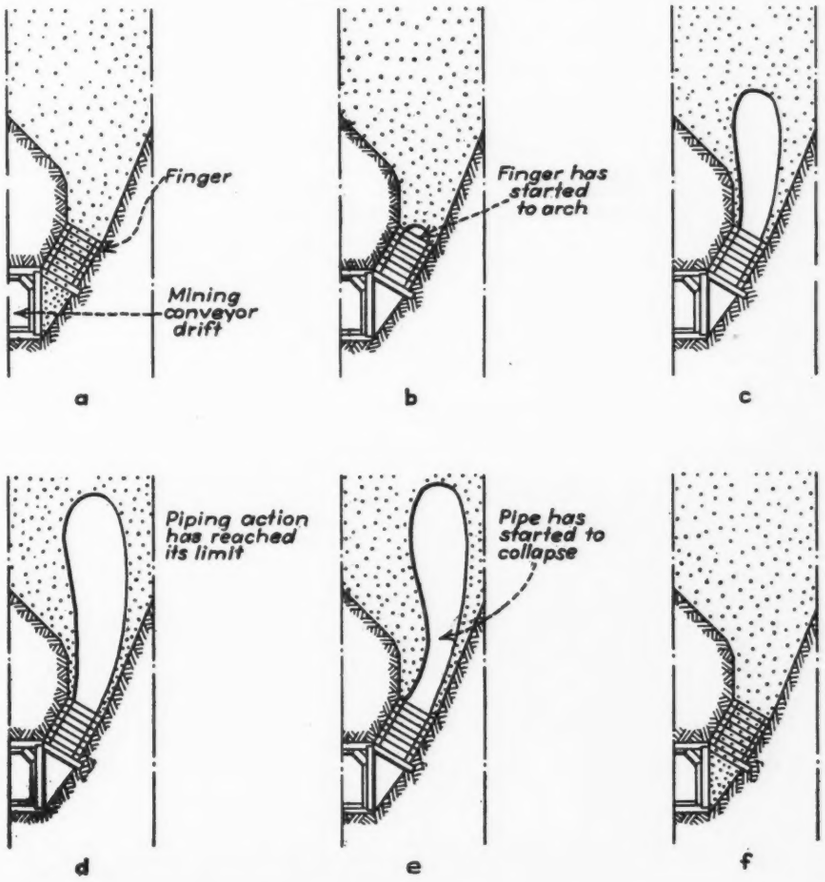
Advantages of Fast Drawing—Besides transferring weight from the extraction openings, fast drawing has other advantages. The repair costs of a panel or block are reduced directly as the panel life is shortened. If a block, for example, were drawn out in two months with the conveyor method instead of eight months with the present branch-raise method, the maintenance costs would be reduced proportionately, reducing the draw area to a fourth of that required for a given tonnage as compared with present methods.

The problem of maintenance may be looked at from still another point of view. Assume the height of ore to be 190 ft., or 15 tons for each square foot of area, and the repair cost for the life of the block to be 8c. per ton. This would be equivalent to $1.20 per square foot of undercut area, and if converted into costs per foot of drift (on 30-ft. centers) would be $36.00 per linear foot for drift repairs. If properly organized the drifts could be driven and lined with concrete or steel for slightly more than the present maintenance costs.

Supervision, Supplies, and Safety—Supervision, the importance of which cannot be overestimated, will be ideal because of centralized operations. Raises are one of the big hazards of mining. The elimination of raises, and the improved supervision owing to the centralization of operations, will materially reduce accidents. Supplies will be delivered expeditely and with minimum effort by reversing the conveyors.

Tools Available Today—Practically all the tools and data for mechanized mining are available today. The mining industry needs a Central Bureau to help work out general plans and standardizations. Services of this nature are rendered many other industries today, and to a limited extent for the mining industry by the United States Bureau of Mines Experimental Stations. This Central Bureau, working in close cooperation with the mine management, would gather, sift, correlate, classify, and augment data from all sources having a bearing on cave mining. The Bureau's experimental laboratories would test all machines, giving particular attention to inclined conveyance machinery, and will conduct much-needed research experiments in rock physics.

Fig. 4 . . . Three sketches illustrating so-called "piping" or caving action that occurs in drawing the caved ore



In various industries many practices are in use today that can be advantageously employed in caving operations. In one installation 5,000 tons of material hourly are being conveyed a mile and elevated 560 ft. On another project a 10-mile conveyor system is to be installed. Weighing machine and photo-electric cells in many installations are used in conjunction with belt conveyors. Many experiments have been performed and many formulas have been developed in designing retaining walls, ore and grain bins, and building foundations that will help in understanding earth pressures. Only guiding skill and vision, combined with practical mining experience, are required to make conveyorized mining successful.

All these improvements will not take place at once, because the underground metal-mining industry—of all industries—is slowest to adopt the new or unknown. Mining is evolutionary. Experience and personal preference, not analysis and logic, usually determine choice of the method. Many of the improvements are forced upon operators by necessity. The mechanization of the coal-mining industry is an example.

To obtain the maximum benefits of complete mechanization the design of the mine plant should receive the same careful planning that is employed in the larger construction projects. This does not mean that the existence of all ore has to be known in advance, but it would be highly advantageous to have as much information on the orebody as possible before designing the plant. Exhaustive studies of all factors involved should be made before development work is started. A high degree of engineering skill will be required properly to plan and develop orebodies for application of conveyor mining.

Natural Resources Increased Through Mechanization—The high-cost caving methods, top-slicing and sublevel caving, are often chosen over the cheaper undercut caving methods because of better extraction. Conveyorized cave mining, with its lower mining costs, efficient drawing, and high percentage of ore recovery, will be substituted for many of the higher-cost methods. Much material that is not minable today will become profitable ore tomorrow. This will greatly increase the natural resources. Instead of present-day production ranging from 12 to 27 tons a man-shift, tomorrow's production will be increased to 70 tons a man-shift. This will take place when mechanization is developed and earth pressures are understood—when theory and practice are coordinated, and when all mining operations are synchronized.

Patents are pending covering the mechanized mining method disclosed in this paper.

In the La Platas

A promising area of southwestern Colorado that invites earnest systematic prospecting

Early summer in La Plata valley, Parrott mountain on the left. Gold was first discovered in this region in 1873

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AS DESCRIBED by Whitman Cross in Folio No. 60, published in 1901 by the U.S. G.S., the La Plata Mountain group is situated "in the southwestern corner of Colorado, some twenty miles southwest of the San Juan Mountain front. The intervening space is heavily timbered hilly country, occupied by Paleozoic and lower Mesozoic formations. Westward the level expanse of the Dolores plateau stretches far toward the canyon of the Colorado River. On the southwest, and rising nearly two thousand feet above the plateau, is the famous Mesa Verde, dissected by the deep canyons of the Mancos River and its tributaries. Thus, the region presents varied physical features, but the most prominent element of the geography is the rugged La Plata Mountain group occupying the greater part of the northeast section of the quadrangle."

The La Platas are the remnants of a domal uplift of sedimentary rocks ranging in age from the Pennsylvanian to the Upper Cretaceous. The uplift evidently was caused by "the intrusion of stocks, dikes, and sills of igeneous rocks."[1] The center of disturbance was about Diorite Peak, a few miles north of La Plata, and Lewis Mountain, at the head of Lightner Creek. From this center the drainage has a roughly radial system, the master stream being the La Plata River, which has cut its head almost to the northern rim of the mountain group. Only a narrow divide separates it from Bear Creek, which flows northward into the Dolores River. The vigor of this erosion is shown by the fact that the present head of the La Plata is about a thousand feet lower than the mountains at either side. The fall in the first three miles of this stream, according to Cross, is about 1,200 ft. Then the slope becomes more gradual, the flow less boisterous, and the upturned edges of the sedimentary strata form bedrock riffles, converting the river into an enormous sluice box from which some genius may some day make a clean-up. The chief obstacles seem to be the huge boulders rolled down the valley sides by freshets in ages past.

The first discovery of lode gold in these mountains was made in the fall of 1873, by a party of adventurous prospectors, when the region was inhabited by Indians, many of whom were hostile to white men. Early the following summer the prospectors returned, bringing with them from Del Norte Capt. John Moss, a California miner who was scouting for Parrott brothers, of San Francisco. Locating 3,000 ft. of the vein they had discovered, naming it the Comstock lode, they sank a shaft in the center, 40 yd. south of a rushing stream which they named Root Creek, after one of their number—Almarion Root. Other geographical features perpetuating the memory of these pioneers are: Tiburcio Creek, Parrott Peak, Lewis Creek, Lewis Peak, Mount Moss, Wahl's Creek, and the Parrott fault, which cuts through the range between the La Plata River and the East Mancos, separating Parrott Peak from Madden, and followed by Root Creek on the eastern slope.

News of the discovery soon brought the usual stampede of prospectors and adventurers. The California Mining District was organized, a small camp established at the mine, and the town of Parrott built at the entrance to the valley, two miles downstream from the shaft. It soon became a roaring frontier town and the seat of Montezuma County, which then covered the entire southwestern corner of Colorado. Parrott remained the county seat for several years, until the coming of the railroad to Durango (1880) and the A. S. & R. smelter (1881) made this Animas River town the metropolis of a rich mineral and agricultural empire and La Plata County was carved out of oversized Montezuma.

Ore from the Comstock was hauled by ox teams to Pueblo for smelting—

[1] Edwin B. Eckel: Colo. Sci. Proceedings, 1936.

more than 300 miles over high mountains, though the road west of Del Norte was little more than a pack trail. Within 40 ft. of surface $75,000 to $80,000 was produced, and old-timers reported much more was "high-grade." When the bonanza was worked out the owners disagreed on development plans, only sufficient work was done to patent the lode claims and establish a millsite on the river; and for the past sixty years little work has been performed by other than occasional lessees. The ebb and flow of population, rising after each new "strike" and falling almost as rapidly thereafter; the several financial depressions; jealousy of competition, and the closing of the Durango smelter in 1931, have retarded development of this interesting district.

Although many small mines shipped high-grade ore from time to time and made local history, no important strike was made for nearly thirty years after the first discovery. Then, in 1902, an old prospect near the head of Junction Creek was revived as the Neglected mine; ore reported to run as high as $1,000 a sack was packed down to the smelter, and two Durango plumbers became comparatively wealthy within a year. And on the eastern bank of the La Plata River, just above the entrance to the valley, rich quartz carrying free gold and tellurides was discovered on the Valley View claim, initiating activities there which led to the opening of the Idaho mine, and, on May 1, 1903, the discovery of the May Day mine, on a trail over which prospectors had tramped for almost three decades.

At the depth of 20 ft. the May Day was optioned to the late A. E. Reynolds, veteran mine operator, for $50,000. Profits from the next 50 ft. of shaft paid for the property, according to reliable information at the time.

Production figures prior to 1902 are not available, but from that year to 1914 the output of the district, according to the United States Bureau of Mines, was over $3,500,000, chiefly from the Neglected, Idaho, and May Day mines. Since 1914 the production has been well above $2,500,000, of which about $500,000 came from the Gold King mine, which closed down late in 1937, after ten years of successful operation.

About thirty years after the discovery of the Idaho and May Day, the La Platas again entered the spotlight through the finding of coarse free gold on the northern bank of the East Mancos River at a point about opposite where the earliest discovery was made on the La Plata. Because the finder had picked up an arrow head at the place where his first rich panning occurred, the claim was named the Red Arrow. As digging proceeded along the thin streak of "colors," they gradually became more numerous and coarser until, back in the solid formation, small nuggets and sheets of gold appeared in fractures in the sandstone.

The find brought wide publicity by newspaper, screen, and radio, and the subsequently silent period due to a lawsuit and a change of management, caused doubt as to the veracity of the early reports of fabulous richness. The truth is that since the vein, inconspicuous at surface, was opened to solid formation, the output from development alone has sufficed not only to pay costs but to build up bank accounts and provide all the luxuries of modern life for the fortunate owners. Practically pure gold occurs in seams and fractures in the "La Plata sandstone," varying in size from small grains to slabs the size of one's hand. Operations have been continuous since the discovery, and it is reported that hardly a month has passed without at least one shipment of rich ore or bullion; although during the lawsuit, in which an interest was sought by a former associate of the discoverers who, it is alleged, had become discouraged and dropped out of the party before the discovery of the Red Arrow, the mining operations were not rushed. Indeed, it seems that the operation has never been intense. There was the supply, always available. It could be drawn upon as desired and its conversion into goods or real property required no expensive metallurgy; for only a small grinder and some form of amalgamator suffices for most of the ore. Hence, the Red Arrow has proceeded slowly and without ostentation.

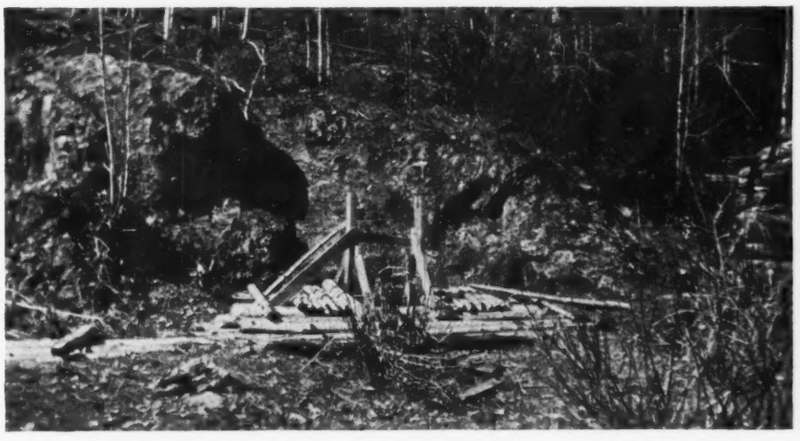
Now, however, with accumulated stocks of mill ore and a large area patented, it seems that a more active program is to be adopted by the management; for published reports[2] announce that an amalgamating and cyanide mill is contemplated, that 25 men are employed, about 40 tons of rich ore is shipped each month, and that 3,000 ft. of development work was done in 1938.

The aforesaid work of Whitman Cross still stands as authority on the geology of the California Mining District, and it will so stand until the publication of the recent work of Edwin B. Eckel and party, of the United States Geological Survey, who made a careful resurvey of the geology and ore depoits in 1935 to 1937. Cross' work was ably done, though quickly, with the aid of Arthur Coe Spencer and Chester Wells Purington; but subsequent mining operations have opened much new territory, revealing some errors in conclusions by the first geologists and providing opportunity for study underground of important areas which were not accessible when the La Plata folio was in preparation. It will interest many readers to note here that Mr. Eckel was associated during the resurvey with the same Arthur Coe Spencer who was with Cross on similar work nearly half a century ago, active and alert as in his youth.

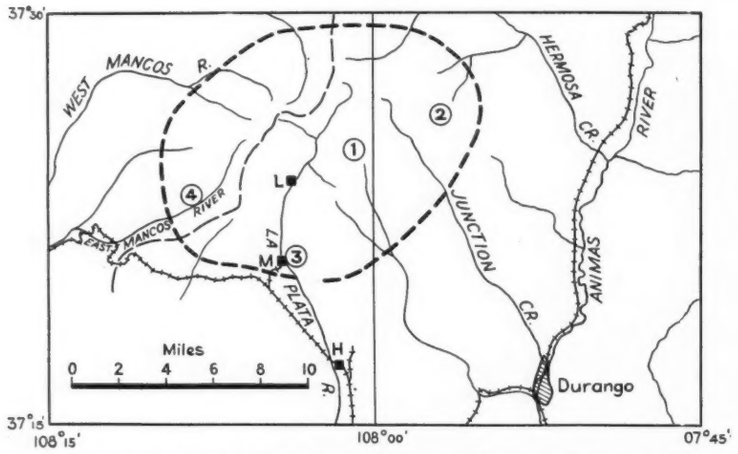
This resurvey has served to correct several errors in the published geology of the region and will shed new light on the mode of occurrence of many of the ore deposits, thereby indicating a more intelligent line of prospecting and development. An area of 120 square miles was examined and mapped in detail, and every accessible mine working and prospect hole was studied. The publication of the report will no doubt introduce a new era of activity in the district; but its preparation will require several years to complete.

For this reason Mr. Eckel prepared a synopsis of his first season's work, which was published by the Colorado Scientific Society in 1936 as a brochure. Though its scope is limited, covering only the first summer's work, it will be of value and interest to all operators and prospectors in the La Platas. It describes every formation in the district, including the different

The Comstock shaft, where the first discovery of gold was made



[2] *The Mining Journal*, Phoenix, Ariz., Feb. 15, 1939.



Map showing location of the La Plata district, southwestern Colorado. After a map by Edwin B. Eckel, in *Proceedings* of Colorado Scientific Society, Vol. 13, No. 9, p. 509. L, town of La Plata. M, May Day (Parrott). H, Hesperus. 1, Gold King mine. 2, Neglected. 3, May Day-Idaho. 4, Red Arrow

porphyries and other igneous rocks, showing their location on a map covering all the northern portion, as far south as the old camp of La Plata. It tells which formations are most favorable for open fissures and vein formation, describes the ore occurrence in a number of mines, and shows a block digram of the Idaho and May Day mines, exhibiting the faults, fissures, veins, orebodies, and the various geological formations in the five miles of workings in these properties.

Referring to the May Day and Idaho, Mr. Eckel states (p. 545):

"There are two distinct sets of fractures. One of these trends nearly due east and consists of several faults with large vertical and possibly large horizontal displacement. The two main faults of this set are known as the Idaho and May Day faults. These are marked in most places by a crushed zone ranging from about 2 to 20 ft. in width and by abundant gouge, which is present regardless of the character of the immediate wall rock. So far as known these faults are essentially barren of ore deposits.

"In addition to the strong east-west faults there is a series of veins that trend nearly due north and follow faults of comparatively small displacement. These faults appear to be older than the east-west faults and to be displaced by them. . . . Most of the production of May Day and Idaho mines has come from the Idaho vein north of the Idaho fault, from the May Day vein north of the May Day fault, and from the Valley View vein between the two faults. . . . Most of the ore so far extracted has been found relatively close to the intersections of the veins with the barren faults. There appears to be sufficient evidence to prove that the east-west faults were in existence before the period of ore deposition and that the strong gouge zones acted as dams and in large part guided the ascending ore-bearing solutions." (p. 546)

The preceding paragraph is so significant that a more general dissemination of this information should give impetus to the now languishing prospecting in the district and lead to new important discoveries. Despite the production of rich ore south of the fault at Comstock and Lucky Discovery, the Parrott fault is still devoid of any work on its northern side, probably because the overburden conceals the outcrop; and for the same reason there may be undiscovered mines in the soil-covered area south and east of the May Day and Idaho, and in similar areas of known or suspected faults.

As has already been related in the foregoing, important discoveries in the La Platas have occurred about thirty years apart; but, with the present knowledge of the geology and ore occurrence, intelligently directed prospecting and development work should considerably augment the average output. And to the credit of this versatile, if not always prolific, region, it may be stated that since the first discovery of gold the production has been continuous—small at times, but always something.

Although the "La Plata sandstones" appear to be the most favorable formations for rich deposits, they are not by any means exclusive, for valuable orebodies have been mined from every formation in the district, though the McElmo shales are almost beyond the upper limit.

The Cutler beds, which are soft and yielding where not metamorphosed, have been regarded by many as unfavorable to ore deposition, but Eckel points out that the Gold King mine is in the Cutler and Rico beds—below the Cutler—and the deposits are of the same character in both formations. Similar deposits occur in the Lucky Strike prospect, west of the La Plata River and 1,000 ft. south of Basin Creek and some ore has been taken from the Cutler beds in the Idaho mine. The Neglected is another rich mine which has produced well from the Cutler formation. It should be noted that in these mines the shale beds have been silicified or otherwise hardened by metamorphism and rendered capable of fracturing and of maintaining open fissures.

A large part of the production of the May Day, Red Arrow, Lucky Discovery and other high-grade mines has come from the "upper La Plata sandstone," which is one of the most favorable formations. These mines and the Jumbo, Incas, and Century have also produced richly from the "lower La Plata sandstone"—now referred to as the "Entrada sand."

Not all the east-west faults in the district are barren of values, for the Gold King vein follows such a fault, albeit the main production has been from a body of breccia through which the fault passes.

The Neglected vein is associated with a porphyry dike, being partly in the dike and partly on either wall. Dike-like bodies of porphyry are common in the May Day and Idaho mines, and one of them follows the Idaho fault throughout.

With the exception of the Gold King, all the rich producers of the district are in fresh rocks, four to six miles from the center of the uplift, and in the sedimentary areas. But many small mines have been worked in or near masses of diorite near the center of uplift, including the Columbus, Small Hopes, Sara G., Mountain Lily, Tomahawk, and Little Kate, most of which have been idle for many years.

Another type of deposit is the pyritic replacement in limestone, of which the most prominent occurrence is in Jackson ridge at the head of the East Mancos River. Here the "La Plata limestone" has been partly replaced by quartz and pyrite carrying considerable gold, locally characterized as a "blanket vein." It lies upon the "lower La Plata sandstone" and was opened and worked by short adits many years ago, the quartz being crushed in a battery of homemade wooden stamps. In 1900 a two-stamp Tremain battery with amalgamating plates and a Wilfley table stood at the foot of the hill, recovering $100 to $125 per ton from the oxidized ore and leaving $20 per ton in the tailings. The property was sold and subsequent attempts to exploit a large area have proved unprofitable.

Elsewhere in the district rich orebodies have been found where vertical veins intersect this La Plata limestone. In the Idaho mine, according to Eckel, solid masses of rich tellurides several feet in diameter have been mined from this formation.

Much of the richest ore in this district is quite complex, for many base metals occur with the gold and silver.

Sphalerite and galena indicate good values in the precious metals in some places; and tellurium is a common constituent of the richest ore.

Platinum-group metals have long been recognized in the black sand of the placers, but not until recently were they found in place in these mountains. A brochure prepared by Mr. Eckel and published last year by the Colorado Scientific Society describes the occurrence of platinum and palladium in a low-grade copper mine about one-half mile north of the old town of La Plata. This is the only copper deposit in the district which has been worked on a commercial scale. The platinum was found in samples of chalcopyrite from the dump of the Copper Hill mine. The brochure, entitled "Copper Ores From the La Plata District and Their Platinum Content," relates that this mine has shipped 2,336 tons of ore, which produced 223,865 lb. of copper, 4,478 oz. of silver, and 12.26 oz. of gold. No estimate of the average value can be made from the data at hand, but the published report states, "It seems highly probable that the ore now exposed will be found to range from 2 per cent to 4 per cent copper, and if the ratio of platinum metals to copper falls within the ranges indicated by available determinations, it seems possible that the crude ore in place (in the glory hole) will contain about 0.02 to 0.06 oz. platinum, 0.02 to 0.04 oz. palladium, and 0.14 to 0.16 oz. silver per ton. As chalcopyrite is widely distributed in the central portion of the La Plata district, similar deposits probably warrant further investigation . . . possibly by means of drilling."

In spite of the distance from large centers of population, the La Platas possess many natural advantages, and the railroad and highway passing through Hesperus make the mining areas easily accessible. Timber and water are plentiful, excellent coal is mined at Hesperus, a large oil refinery at Farmington provides cheap fuel oil, the large valleys south and westward supply a great variety of food products at low prices, and labor is plentiful and more reasonable than in most mining camps of the State. Because of the altitude (the mines generally are between 9,000 and 10,000 ft.) the winters are rigorous; but, on the whole, the climate is pleasant and healthful.

Considering that a large part of the mineralized area is covered with vegetation, making the old-time methods of prospecting difficult; that production has been continuous for many years; that a number of rich mines have been discovered in widely separated areas—the latest within only a few years—this district undoubtedly justifies earnest, intelligently directed, and systematic prospecting.

Mining Flourishes in Norway

The year 1939 was good, but the future is obscure because of war conditions on the Continent

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THE mining industry of Norway has so far not been severely upset by the war situation. It has been harder than usual to obtain information, but in all probability the production and economic results of 1939 will be similar to those of 1938, the official statistics of which have recently been published. They state that the year was the best on record since mining statistics were started some 80 years ago. They give the total ore and concentrate production as 2.6 million metric tons at a value of 57.4 million kronen delivered at the mine or concentrator bins. The corresponding figures of 1937 are 2.21 million tons and 45 million kronen and those of the boom year 1929 are 1.56 million tons and 34.11 million kronen. In these figures are not included the coal production of the Norwegian arctic colony of Spitzbergen, which lately has amounted to some 700,000 metric tons, of which around 300,000 came from the Norwegian-owned mines, the remainder from the Russian mines.

The principal products of Norwegian mining are iron ore, cupreous and non-cupreous pyrites, copper ore, nickel ore, molybdenite, zinc ore, silver ore, and graphite. Official statistics of 1939 will not be available until late in 1940, but private information shows pretty clearly that there will be no great difference from the production figures of 1938.

Iron Ore—In 1937 the production of iron ore (concentrates and lump ore) for the first time in the last two decades surpassed the production of cupreous and non-cupreous pyrites both as to quantity and value, amounting to 1.08 million metric tons against 1.05 million tons. Further development in the same direction was shown in 1938, the iron-ore production increasing to 1.47 million tons, whereas the pyrite production receded to 1.03 million tons. Iron ore is now the most prominent product of the Norwegian mining industry, and its value constitutes nearly one half of the total.

By far the most prominent producer of iron ore is the Sydvaranger concern, located at the northeast corner of the country near the border of Finland. A striated ore of magnetite and quartz in alternate layers and with an average of 34 per cent Fe is concentrated to a product of 66 to 67 per cent Fe, of which about one-third is briqueted. The concentrate is very free from impurities with the exception of its small percentage of quartz, and it is highly favored by the blast furnaces. Besides concentrates a certain amount of lump ore is produced, containing 50 to 55 per cent Fe.

Next comes the Fosdalen mine, north of Trondheim. Besides magnetite the crude ore contains an appreciable amount of pyrite, which is floated out of the tails from the magnetic separation of the magnetite. Production amounts to approximately 200,000 tons of high-grade magnetite concentrate, with 4,000 tons of flotation pyrite as a byproduct.

Of the other iron ore producers the Dunderland mines, in Rana, and the Ofoten mines, at Bogen (both in northern Norway), have stopped production since the outbreak of the war. Both are treating very poor ore containing a mixture of magnetite and hematite. At Bogen 4½ tons of ore have been necessary to produce one ton of concentrate. Economic production is very difficult under such circumstances, and a revival of the Bogen mines seems improbable.

On account of the closing of the two mines named, and because of various export difficulties, the 1939 production of iron ore will probably fall about 100,000 tons short of that of 1938.

Cupreous and Non-Cupreous Pyrites—In 1936 the pyrite production passed one million metric tons a year for the first time. It has kept above that figure in the following years and will probably do the same in 1939. About three-fourths of this production is made up of lump ore, crushed pyrites, and washed concentrates, the remain-

This contribution from Mr. Böckman unfortunately was received too late for publication in the February Annual Survey and Outlook Number, for which it had been solicited.

ing one-fourth being flotation concentrates. Sixty per cent of the total is cupreous pyrites.

The main producers are: The Orkla mine, to the southwest of Trondheim; the Sulitjelma mines, east of Bodö, in northern Norway; the Björkaasen mine, in Ofoten, in northern Norway; the Stordö mine, south of Bergen; the Vigines mine, south of Bergen; the Foldal mines, in the middle of southern Norway; and the Killingdal mine, in the mountains south of Trondheim. Of these mines Orkla will produce around half a million tons, Sulitjelma, Björkaasen, and Stordö around or above 100,000 tons each.

Pyrite mining does not seem to have been affected greatly by the war. No mines have closed down and no new ones have been put in operation. The pyrite production makes in tonnage about 40 per cent and in value about a third of the country's total mine production. Pyrites and iron ore together make about 90 per cent of the tonnage and 80 per cent of the value.

Copper Ore and Zinc Ore Production—Besides pyrites the mines mentioned in the foregoing also produce copper concentrates and zinc concentrates by flotation. Such concentrates are made by Sulitjelma, Björkaasen, Vigines, Foldal, and Killingdal. Sulitjelma is in fact the principal producer of metallic copper in Norway, its copper concentrate being treated in its own smelter to a high-grade blister.

The other copper producers are the old Röros mines, of nearly 300 years of production. Their only yield in the later years has been copper concentrates, which is smelted to refined copper of highest quality. At Kristiansand copper is also produced but principally from imported ores and matte. Orkla Metal is an affiliated enterprise of the Orkla mine and treats the cupreous pyrite of the latter for production of native sulphur, yielding a high-grade copper matte as a by-product.

The copper concentrate production of 1938 amounted to 35,000 metric tons, valued at 5 million kronen. Including the copper matte production of Orkla Metal and the copper conents of the produced pyrite, the copper production of Norway will come near to 18,000 tons of metal. Hardly 40 per cent of this is converted to metallic copper in the country itself.

Zinc Concentrate—This is actually produced only as a byproduct of the pyrite ore flotation. Our only zinc mine of later years, the Mofjellet mine, at Rane, in northern Norway, closed down in the middle of 1938 and has not been reopened. Sulitjelma is also the biggest zinc concentrate producer. The production of the other pyrite mines is on a much more reduced scale. Total production and value in 1938 is reported as 15,000 metric tons of concentrate, equal to 0.68 million kronen. In 1939 it will probably be below 13,000 tons. Most of the concentrate is exported. On the other hand, the smelters at Odda and Glomfjord have a fairly big zinc production from foreign ores.

Nickel Ore—This is produced by two mines belonging to the same concern, the Hosanger mine, at the west coast, and the Flaat mine, north of Kristiansand. The production of both is smelted at Evje, near the Flaat mine, and the matte is refined at Kristiansand. Production is around 1,000 metric tons of nickel and 700 metric tons of copper.

Aluminum Ore—This is not mined in Norway, but imported ore is largely treated at the big hydro-electric plants of the country.

Molybdenite—This mineral has given rise to a mining industry of importance in the later decades. During the war of 1914-18 molybdenite was produced at a lot of small mines, all of which closed down at the end of the war. Some years later the biggest of these mines, the Knaben, at Fjotland, started up again and by the use of modern flotation was enabled to exploit the extensive zones of poor disseminated ores which surround the previously known vein deposits. Until two years ago Knaben was the sole producer, yielding in the later years 600 to 700 metric tons of concentrate (100 per cent MoS_2). Now one or two other enterprises have been started, but so far are producing only on a comparatively small scale.

The molybdenite production of 1938 is reported to be 775 metric tons at a value of 3.2 million kronen. The production of 1939 will probably be about the same.

Graphite Production—This has attained some importance in Norway lately. In the early thirties the Skaland mine, on Senja, in northern Norway, was opened and has steadily increased its production. Two years later the Holandsfjord mine, south of Bodö, was started. The combined production of the two mines will be about 4,500 metric tons of high-grade sieved concentrates.

Silver mining in Norway is undertaken only by the state-owned enterprise of Kongsberg, where veins of limespar carrying native silver are exploited. Mining on these veins has been carried on for over 300 years. The actual yield is 7,000 to 8,000 kg. of refined silver a year. The coarse silver is picked and the remainder concentrated by flotation and leached by cyanidization.

Norwegian mining has had a very satisfactory development in the last decade, but of its future nothing can be prophesied under the present circumstances. If the war situation does not spoil everything, its outlook ought to be a bright one.

PINITE—A New Refractory

A LARGE NUMBER of secondary minerals derived from the alteration of feldspar, nepheline, scapolite, spodumene, piolite, etc., are classed as pinite, according to Paul M. Tyler, of the Bureau of Mines, in *Mineral Trade Notes* (Vol. 9, No. 5). In composition, pinite closely corresponds to muscovite, essentially a hydrous silicate of alumina and potash. Agalmatolite is a massive pinite resembling steatite or pyrophyllite in appearance. Other varieties resemble sericite. As early as 1933, a large deposit of material identified by P. F. Kerr as pinitized tuff was discovered on the east side of the Humboldt range near Rochester, Nev. According to O. C. Ralston, of the Bureau of Mines, who recently visited the deposit, V. R. Sullivan, who optioned the claims and undertook preliminary development, began shipments to the Stockton Fire Brick Company a year or two ago. During the first eight months of 1939 this company mined and delivered to its plant in Pittsburg, Calif., at least fourteen cars of the material, which is used principally in rotary-kiln linings at cement plants.

As described by Messrs. Page, Raine, and Sullivan, of the Stockton Fire Brick Company, in a paper read before the American Ceramic Society last August in San Francisco, the important properties of pinite as developed to date are refractoriness, ease of raw grinding, snow-white color after firing, inversion to mullite at relatively low temperatures (1,125 deg. C.), low and reversible thermal expansion, absence of free silica, extreme hardness and resistance to abrasion of the fired product, low firing shrinkage, high density after firing, and resistance to molten enamel slags. The reversible thermal expansion of commercial pinite refractory is said to be lower and more uniform than that of kyanite, super-duty refractories, acid-resistant brick, Missouri super-duty refractories, or china bodies. Like clay, it will bond alone. It is claimed that in the cold zones of rotary kilns and in the coolers that take the discharge from rotary kilns, Rochester pinite linings last much longer than linings of other materials; and they have been used in the calcining of cement clinker, magnesite, and limestone since 1936. The unusually large cement kilns now being erected for the mammoth new cement plant near Los Gatos, Calif., are to be lined with pinite, which also may be used eventually for pebble-mill grinding media and liners.

The deposit, as described by Ralston, is 25 miles from railroad at Oreana, near the ridge separating the fork of American Canyon from the main valley.

Some Recent Uses of

CHARCOAL AS A GOLD PRECIPITANT IN CONJUNCTION WITH FLOTATION

Instances are cited from operation and laboratory work conducted in this country as well as abroad

M. W. von Bernewitz
Metallurgical Engineer

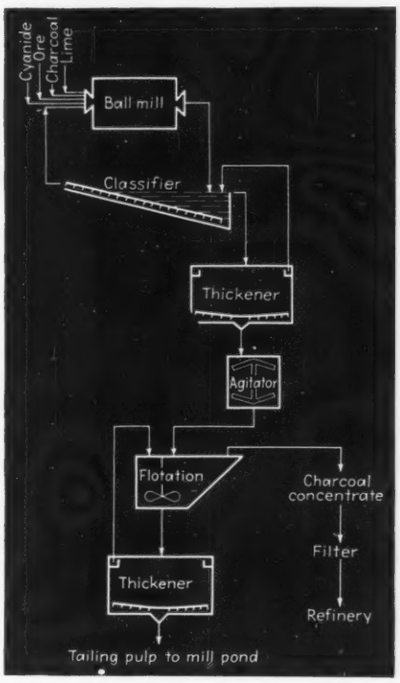

Fig. 1 . . . Flowsheet of single-stage simultaneous dissolution and adsorption cyanide process. From U. S. Patent 2,147,009, issued to T. G. Chapman, Tucson, Ariz., Feb. 14, 1939

AT THE ANNUAL MEETING of the Rio Tinto Company, Ltd., held in London on April 28, 1939, the chairman of directors, Sir Auckland Geddes, made the following statement:

"A new feature of our operations (in Spain) has been the recovery of gold in the form of a concentrate from the ferruginous gossans forming the capping of one of our lodes. As a result of experimental work carried on for some time in conjunction with Minerals Separation, Ltd., a novel process has been perfected utilizing cyanide as the solvent and activated charcoal as the precipitant of the gold, which is recovered by flotation. We have thus been able to deal satisfactorily with a very low-grade gold ore and to put into service our concentrator, which was built to treat cupreous ores, but which had been idle since 1932 . . ."

In reply to a question regarding this process, the office of the company secretary, J. Davidson, London, stated that somewhat more than 1000 tons was being milled in 24 hours. The gossans average rather less than 3 grams (say 0.087 oz., $3.25 per short ton) of gold and 35 grams (say 1.03 oz., 40c.) of silver per metric ton. Of the gold, only about 80 per cent is amenable to cyanidation. The ore includes considerable and varying proportions of clayey matter, which, when excessive, affects the recovery. The ore is ground with the activated charcoal in cyanide solution to 70 per cent minus-200 mesh. Adsorption of the dissolved gold on the charcoal is almost 100 per cent. The recovery of the charcoal by flotation is usually over 90 per cent, which gives an average over-all recovery, in the form of concentrate, of about 87 per cent of the soluble gold and 70 per cent of the total gold in the mill heads. Better recoveries have been realized over long periods. The recovery of silver is low.

Rio Tinto is operating under British Patent 458,598 of Dec. 22, 1936, applied for by W. J. Tennant and Stanley Tucker. In the claims the charcoal is added to the grinding circuit.

This operation, together with the recent issuance of several patents relating to this type of the work done by Rio Tinto, as well as general interest, call for a review of the situation. No comment is offered beyond the statement that I have had rather puzzling experience with carbonaceous schist and would not care to have a gold-charcoal mixed with pulp in agitators and thickeners.

Use of charcoal in the precipitation of gold and silver from cyanide solution, and results of experiments thereon, were completely covered by John Gross and J. W. Scott in *Technical Paper 378* of the Federal Bureau of Mines (78 pages, 1927), "Precipitation of Gold and Silver From Cyanide Solution on Charcoal." Their bibliography goes back to 1830, and in 1880, United States Patent 227963 was issued to W. N. Davis for the use of carbon for precipitating gold from solution and subsequent burning. Gross and Scott investigated the suitability of woods for making charcoal and the importance of activating charcoal, and found that 200 mesh is fine enough for precipitation.

In 1926, Gross and Scott made a test to determine whether the soluble gold and silver might be recovered from a mixture of ore and cyanide solution by adding pulverized charcoal and then recovering the charcoal by flotation. Flotation had been suggested in print in 1918 by P. T. Bruhl and in 1922 by André Dorfman for

the removal of carbonaceous matter (graphitic schist) from an ore pulp.

First, experiments were run on the flotation of charcoal from a cyanide solution that did not contain ore. A satisfactory froth was obtained and 91.6 per cent of the charcoal was floated. It was found that the charcoal must be added to the pulp and enough agitation given to obtain precipitation before the oil is added, because the oil coats the charcoal and renders it unfit for precipitation.

Then, two tests were run on an ore pulp of oxidized silver ore. In one test, the 100-mesh pine charcoal was added to the pulp just after the ore had been mixed with the cyanide solution. After 48 hours' agitation the pulp was floated. In the second test, no charcoal was added and after 48 hours the pulp was floated with similar reagents to those used in the first test. The assays showed that the precipitation on the charcoal was 68.6 per cent and the amount of charcoal floated was 98.9 per cent. The test with charcoal shows the possibility of precipitation in the pulp and of floating the charcoal, as a fairly clean product, almost completely away from the pulp. No filtration of the pulp is necessary.

Many theories regarding the action of charcoal in the precipitation of gold had been advanced during a period of years, but in 1917, 1918, and 1921, A. W. Allen definitely stated that adsorption without chemical change of the alkaline aurocyanide was the proper explanation. His conclusions were generally accepted, as all known facts seemed to bear him out, according to Gross and Scott in 1927.

The Edquist Process—Apparently, no patents had been issued for this phase of the use of charcoal as a precipitant until V. T. Edquist, well known in Australia, was granted Commonwealth Patent 15635 of June 21, 1934, for "Improvements relating to the Recovery of Gold and/or Silver from Ores and Metallurgical Products." To quote part of the specification:

"This invention consists broadly in dissolving the soluble gold or silver contents in cyanide or other solvent, adding an excess of a precipitant such as powdered charcoal and finally subjecting the pulp to flotation separation so as to obtain a float concentrate rich in precious metals.

"The gold and silver may be recovered from the flotation concentrate containing the charcoal and precipitated gold and silver by any well-known means.

"In treating ore containing soluble gold and silver contents and also gold and silver associated with pyritic minerals, it will be obvious that unless these minerals have a destructive or inhibiting effect on the cyanide the direct method of treatment as above will be satisfactory. If, however, minerals (capable of flotation) are present, which have a destructive or inhibiting effect on the cyanide, it will be desirable to subject the pulp to flotation separation before the addition of cyanide or other solvent. This will give a concentrate containing some of the gold values. Cyanide solution or other solvent will then be added to the remaining pulp, a precipitant being then added and flotation carried out.

"In many cases powdered wood charcoal will be the most satisfactory and economical precipitant. Nevertheless, other carbonaceous material, such as ground coke or graphite, may be employed. In addition, finely divided zinc or aluminum can be used. It has been found that, when using finely divided zinc as a precipitant, there is a tendency for partial re-solution of the gold during flotation, in which case an inert or reducing gas can be employed."

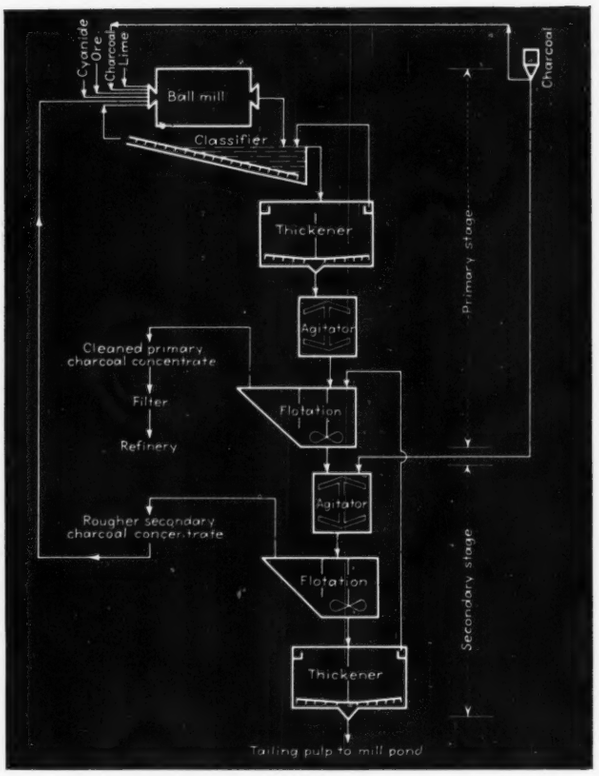

Fig. 2 . . . Flowsheet of double-stage simultaneous dissolution and adsorption cyanide process. U. S. Patent 2,147,009, issued to T. G. Chapman

Edquist's examples of tests cited gave one in which gold-bearing slime agitated four hours with 0.04 per cent cyanide solution gave a recovery of 93 per cent with 3 lb. of charcoal per ton of slime; and one in which gold-bearing ore was slimed in 0.02 per cent cyanide solution. Free gold was removed by corduroy and the total recovery was 97 per cent with 5 lb. of charcoal per ton of ore treated.

The Edquist process was tried during 1934 at the Mount Morgan gold-copper mine, Queensland, and A. A. Boyd, managing director, has generously supplied the following information as to how charcoal was adapted there to the flotation process:

"Two mills are now operating at Mount Morgan, one treating oxidized ore and old dump material by cyanidation, with standard zinc-dust precipitation of the gold [395,800 tons ore and 164,833 tons tailings in 1938-39]; the other mill treating sulphide and partly oxidized ore by fine grinding and flotation of a gold-copper concentrate [473,450 tons ore in 1938-39]. It was in this plant that the Edquist process was tried.

"The cyanidation, charcoal-precipitation, flotation process has not been used here since 1935.

"From 1932 to 1934, ore was ground to 80 per cent through 200 mesh and floated from a lime circuit using only American Cyanamid Company's reagents 208 and 226. Results were approximately as follows: The feed assayed 6.0 dwt. gold and 0.5 per cent copper, the tailing 2.4 dwt. gold and 0.06 per cent copper, and the concentrate 80 dwt. gold and 10.5 per cent copper, this being an extraction of 60 per cent gold and 88 per cent copper.

"Late in August, 1934, a change was made to the Edquist process. Cyanide was added to the rolls and ball mills ahead of flotation feed thickeners, followed by conditioning with charcoal and flotation for recovery of a gold-copper concentrate containing the gold-bearing charcoal. There followed a period of rapid changes in the plant to find the best conditions.

"Time of agitation of the pulp with cyanide increased from little to a maximum of 16 hours as extra agitators were placed in commission. As no benefit was observed as each additional agitator was used, their construction was stopped.

"The flow finally adopted consisted of a primary float to recover the easily floatable gold and copper, followed by agitation of the primary tailing with cyanide, conditioning with charcoal, and flotation. The recovery in the secondary float did not pay and, after a lengthy test, the process was discontinued.

"At the time of this test the mill was treating 500 long tons per day of ore containing 6 dwt. gold per ton and 0.5 per cent copper. Products from this ore when employing the Edquist process approximated 1.5 dwt. gold and 18 per cent copper in the concentrate and 1.9 dwt. gold and 0.06 per cent copper in the tailing, this giving an extraction of 65 per cent gold and 88 per cent copper.

"Average cyanide consumption was 1.5 lb. NaCN and 5 lb. of charcoal per ton of ore treated.

"Cyanide added to this ore reacts rapidly to form cuprous cyanide, and this is said to be the active gold solvent. At no time was more than 0.5 dwt. gold dissolved per ton of solution.

"As most of the gold in this ore floats with the copper, a figure for the amount of charcoal per ounce of gold is meaningless.

"The concentrate made at the time of this test was sold to the Tacoma smelter, Washington, as a gold-copper concentrate.

"Incomplete precipitation of gold from pulp by charcoal was the main reason for the failure of the process on this ore. The solution accompanying the tailing still contained about 0.2 dwt. gold per ton; tailing went to the dam at 50 per cent solids and it was estimated that only 20 per cent of the water was recovered from the dam, so considerable gold was lost in this way.

"Charcoal used was made from the local timbers (eucalypts), all of which were found to give practically complete precipitation of gold from clean solutions. It was found that temperature control is important during the preparation of the charcoal, the best charcoal being made when the temperature is kept at around 900 to 1,000 deg. C. for approximately 20 min. after final evolution of gases. Charcoal formed under any conditions can be made efficient for gold precipitation by reheating to 900 to 1,000 deg. C. as above. Water-quenching is unnecessary. Local timbers charred under these conditions have precipitation capacities of 350 to 400 oz. of gold per ton.

"In the test the charcoal was wet-ground to 80 per cent minus-200 mesh and added to the pulp as an emulsion. It was soon found that pine oil is absorbed by the charcoal and seriously lowers its capacity for precipitating gold, so the procedure adopted was to condition the cyanided pulp with charcoal before adding the frothing oil. Adding charcoal and cyanide together at the rolls was tested over a period of several weeks without any noticeable benefit. Charcoal was found to be a much better gold precipitant when added to clear solutions than when added to pulps, and some improvement was noted when part of the charcoal was added to the circulating plant solution, but the loss of dissolved gold in the tailing was still serious.

"After the Edquist process was discontinued, the use of cyanide and charcoal persisted for some time. Cyanide was then added in small amounts solely as a pyrite depressant and charcoal as a slime dispersant. This ore contains a good deal of natural slime gangue, whose flotation is retarded by the addition of charcoal. Although cyanide is not ordinarily used now in the flotation plant, some charcoal is still used, particularly on the cleaner flotation cells when the pulp becomes over-oiled."

Laboratory Test on an Australian Ore—During the past year the Edquist process was tried on a soft lode material from Wagonga, New South Wales, Australia, in the metallurgical laboratory of Melbourne University. The ore assayed 0.9 dwt. gold per long ton. It was ground and agitated 20 hours with 5 lb. of lime per ton and a solution strength of 0.05 per cent KCN. All of the lime was consumed and 1.2 lb. of cyanide per ton. Five pounds per ton of freshly made and pulverized charcoal was added and the pulp agitated two minutes more. The pulp was floated and the charcoal concentrate re-cleaned once by flotation. It assayed 62 dwt. per ton, was calcined, and assayed 80 dwt. The calcine was then cyanided 20 hours and 87½ per cent of the gold was recovered. The ore tailing assayed 0.2 dwt. per ton. The investigators reported "This method may prove attractive on account of the absence of filter installations at the mine and because of the close proximity of the mine to the Port Kembla smelters."

The Chapman Process—Fig. 1 of United States Patent 2,147,009, issued Feb. 14, 1939, to T. G. Chapman, Tucson, Ariz., shows a ball mill in circuit with a classifier and being fed with ore, cyanide, lime, and carbon as charcoal. The classifier overflow is thickened and the pulp is agitated in a tank where "dissolution of the gold and its forthwith adsorption by the carbon progresses to essential completion." The gold-bearing precipitant is floated. The precipitate may be thickened or part of it returned to the mill circuit and part sent to a filter and refinery.

This process is not as effective with silver as it is with gold, so any silver present that is not adsorbed by the charcoal may be recovered subsequently by other methods. The process is generally applicable to any ores from which gold is to be extracted by means of cyanide.

In a modification of the process outlined, particularly effective for higher or average grade ores and high-grade concentrates, there are two stages or circuits of charcoal circulation. Fig. 2 shows these. From the thickener that follows the secondary flotation cells, the overflow is returned to the primary cells and the underflow is ponded. By this means,

"dissolved gold is accumulated by the carbonaceous matter and the cyanide solution is substantially depleted of its dissolved gold, and whereby further dissolution of gold from the ore is accompanied by concurrent accumulation of gold by said carbonaceous material, thus maintaining the gold content of the solution in a depleted condition during said concurrent dissolution and sorption,"

to quote part of Claim 18 of the patent.

In Technical Publication 1070 of the American Institute of Mining and Metallurgical Engineers, May, 1939 (15 pages), Chapman describes and illustrates his process under the caption "A Cyanide Process Based on the Simultaneous Dissolution and Adsorption of Gold." As already stated, a patent has been issued, and the Dorr Company has the exclusive right to license use of the process. Chapman does not suggest that the process in its present state of development can compete with current cyanide methods when the ore to be treated is readily amenable to these methods, but the simultaneous dissolution and adsorption process offers considerable promise of treating successfully tailings and ores that cannot be treated to advantage by current cyanide methods. On the whole, the process is not attractive for the treatment of ores containing appreciable amounts of silver soluble in cyanide. Figs. 1 and 2 represent flowsheets of single-stage and double-stage operations.

Tests were run on La Colorada sand-and-slime tailings in Sonora, Mexico. These had probably been leached and agitated and filtered, respectively. There had been appreciable losses of soluble gold in the slime by the original cyanide treatment, but much less in the sand. No sulphides are present. In testing the slime portion of the tailing, recoveries ranging from 65 to 88 per cent of the gold were obtained by simultaneous dissolution and adsorption without grinding. Countercurrent decantation recovers approximately 60 per cent compared to an average of 76 per cent by the Chapman process.

Chapman states that the double-stage process is not as complicated as might appear; for low-grade tailings, satisfactory adsorptions have been obtained with 2 lb. of charcoal per ton, and 3 to 7 lb. for up to 0.4 oz. gold per ton, employing the double-stage process. Thick pulps give better results than thin pulps. Satisfactory recoveries are found with solutions at the end of the process to carry 0.06 to 0.20 lb. of sodium cyanide per ton of solution. Premature precipitation of the gold is not likely to occur, because it is adsorbed as rapidly as dissolved and is not likely to migrate from the charcoal under normal conditions.

It is estimated that the capacity of a given mechanical subaeration flotation unit would be three times as great in floating charcoal as in floating an average sulphide ore. Sulphides may be floated with the charcoal, but each ore must be tested separately to determine whether this is feasible.

Properly conditioned activated charcoal may be rapidly floated. The charcoal concentrate (or precipitate) may be sent to a smelter; or burned, briqueted, and sent to a smelter; or cyanidation of the ash by the Chapman process to raise its grade so that bullion may be produced by melting may be adopted.

Carbonaceous Matter in Ores—Trouble from carbonaceous material as graphitic schist or slate has been experienced along the Mother Lode, Cali-

fornia; in Ontario; in West Africa; and at Kalgoorlie, Western Australia. I had experience with the stuff at the last named place. One never knew when it entered the mill, and the first hint of its presence was high residues, other conditions being normal. If ores are milled in cyanide solution, the gold that is dissolved is readily precipitated on the carbon and this precipitant and the precipitate pass out with the residue. If ores are milled in water, the carbonaceous matter floats and stays around corners, where some of it can be collected by means of any light petroleum distillate and skimmed off. Roasting is not a complete cure, as was found at Kalgoorlie. I studied the problem along the Mother Lode and wrote thereon in the *Mining and Scientific Press* for January, 1914, and forecast further work of similar character.

Depression of Carbonaceous Gangue and Flotation of Pay Minerals—The flotation of charcoal added to an ore pulp is simpler than the flotation of carbonaceous matter forming an integral part of the ore, according to Gross and Scott, cited earlier. In *Ore-Dressing Notes* 9, the American Cyanamid Company, January, 1939, on "New Depressants for Carbonaceous Gangue in Flotation Pulp," says:

"The problem of treating carbonaceous ores has long been recognized as a difficult one, and various methods have been tried, or proposed, for the purpose of overcoming the detrimental effects of the carbonaceous material. These may be classified into two general schemes of treatment as follows:

"1. Selective *flotation* of the carbonaceous material, with as complete rejection of the valuable minerals as possible.

"2. Selective *depression* of the carbonaceous gangue and flotation of the valuable constituent or constituents."

The first scheme of treatment has not been found satisfactory because of mineral losses; the second idea is the more practical, but the lack of suitable depressing agents (starch is rather poorly selective, but it has been used as a carbon depressant at Juneau, Alaska) had precluded the use of this method. As the result of intensive experimentation with various carbon depressants on carbonaceous gold ores (and on a carbonaceous base-metal ore), the American Cyanamid Company found reagents 632, 637, 639, and 645 to have the greatest application. On African auriferous sulphide ore there was a rejection of 49 to 77 per cent of the carbon which existed in shale and a recovery of 90 to 93 per cent of the gold, using ½ lb. to 2 lb. of depressant per ton. On California auriferous sulphides and free gold, the carbon being in shale, the recovery of gold was 91 to 95 per cent, using ½ lb. of depressant per ton. On a mixture of Arizona copper sulphide ore and African barren carbonaceous shale, 61 to 79 per cent of the carbon was rejected, and 96 to 97 per cent of the copper was recovered, using 0.1 to 0.6 lb. of depressant per ton. Even the carbon (0.5 per cent) in a shale of cement rock was largely removed by flotation with 1 lb. of reagent 610.

Reagents 637 and 639, it is reported, have been adopted along the Mother Lode, with the almost complete rejection of carbon and improved recovery of gold, as well as other practical advantages in the plants, including cyanidation. These reagents are most effective when added as dilute solutions of 2 to 5 per cent, 60 per cent of the quantity to the head of flotation or to a conditioner and 40 per cent to the middlings or to a cleaning circuit. An average of 0.4 lb. of reagent per ton of ore should be effective, but the range may be 0.05 to 1 lb. or more.

Another process involving the use of cyanide solution, charcoal, and flotation is that of U. S. Patent 2,186,779, issued Jan. 9, 1940, to Bruce D. Crawford, Grass Valley, Calif., and assigned to the American Cyanamid Company. The title is: "Method of Recovering Gold From Saprolite Gold Ores and Other Refractory Slow-Settling Gold Ores." The one claim reads:

"A method of recovering gold from auriferous saprolite ores which comprises cyaniding a pulp of the ore, treating the cyanided pulp with charcoal which has been preheated to about 1,000°C. and subjecting the mixture to a froth flotation process in the presence of a reagent favorable to the flotation of auriferous carbon."

The saprolite ores have been the principal source of gold in Georgia. They were stamp-milled and amalgamated, giving a low saving. The idea has been prevalent that recovery was affected by the presence of some sulphides and by the fineness of the gold. Saprolite is a clay-like material which generally retains the structure of the rock from which it was derived. It is reddish-brown, has a clayey-irony odor, and slimes badly, another cause for loss of gold. The Federal Bureau of Mines reported in Report of Investigations 3275 (1935, and reprinted in 1939) on some saprolite it had sampled, but the ore was too lean in gold content to warrant any investigation, and stated that the higher price for gold and improvements in mining and metallurgy should add greatly to the possibilities of such border-line ores.

In this latest process the charcoal may be added at the beginning of cyanidation, during cyandiation, or at the end of cyanidation, with little effect on gold recovery. If the charcoal has lost its precipitating power it can be revived by reheating to about 1,000 deg. C. Charcoal made at around 800 deg. C. and higher is preferable.

Three examples of treatment are given in the patent, as follows: Samples assaying 0.062, 0.0998, and 0.0557 oz. gold per ton were milled and cyanided for 20, 24, and 25 hours at a pulp density of 25, 33, and 25 per cent, respectively, with 0.053 per cent sodium cyanide and 0.110 per cent lime equivalents. Charcoal was then added, 2, 6, and 1½ lb., respectively, and 15 minutes was given for precipitation. A Fagergren machine was used for flotation. The reagents used for the first ore were 0.1 lb. per ton of 50:50 sodium diethyl- and di-secondarybutyl-dithiophosphates, and 0.5 lb. each of cresylic acid and pine oil. The second and third ores got 0.3 and 0.45 lb. of kerosene and 0.32 and 0.19 lb. of frother 40 (paraffin alcohols). The respective concentrate assayed 0.740, 4.6321, and 2.8132 oz. gold per ton, and the recovery, 93.77, 86.40, and 95.59 per cent.

In spite of its activation, the much more expensive activated charcoal was not better than cheap pine charcoal, the price of which is about one-sixth that of the other, the patentee says.

Carbon in Mother Lode Ore and Tailings—E. S. Leaver and J. A. Woolf, well-known investigators and writers on precious-metal ores at Reno, Nev., discussed the "Re-Treatment of Mother Lode (California) Carbonaceous Slime Tailings" in Technical Paper 481 of the Federal Bureau of Mines, 1930. They describe the occurrence of sulphides and gold in this ore, how it was milled, and the samples of slime taken from tailing ponds. The carbon content of four lots of slime ranged from 1.15 to 2.24 per cent. After experimenting with direct cyanidation, flotation of cyanidation residues, preliminary roasting, flotation of the slime, roasting and cyanidation of concentrates, and other modifications, it was concluded in part that:

"1. The gold lost in the tails from Mother Lode mills is largely in the remaining sulphides and the carbonaceous portion.

"2. The sand portion usually gives satisfactory recovery by direct cyanidation. As the refractory gold is associated with both the carbon and the sulphides, they must be removed from the sand portion, to obtain maximum extraction, before the sand is treated by cyanidation. Different mine ores or different grades of ores from the same mine may require finer crushing to free the refractory minerals for their removal by flotation.

"3. The slime portion can be best handled by flotation, giving a product that assays 0.61 oz. to 6 oz. gold per ton, with an average of 88 per cent concentration. By special low-temperature roast [because of the arsenic] of these concentrates a calcine is obtained that yields 95+ per cent of the contained gold by cyanidation.

"4. Improved flotation results over former practice on Mother Lode ores are

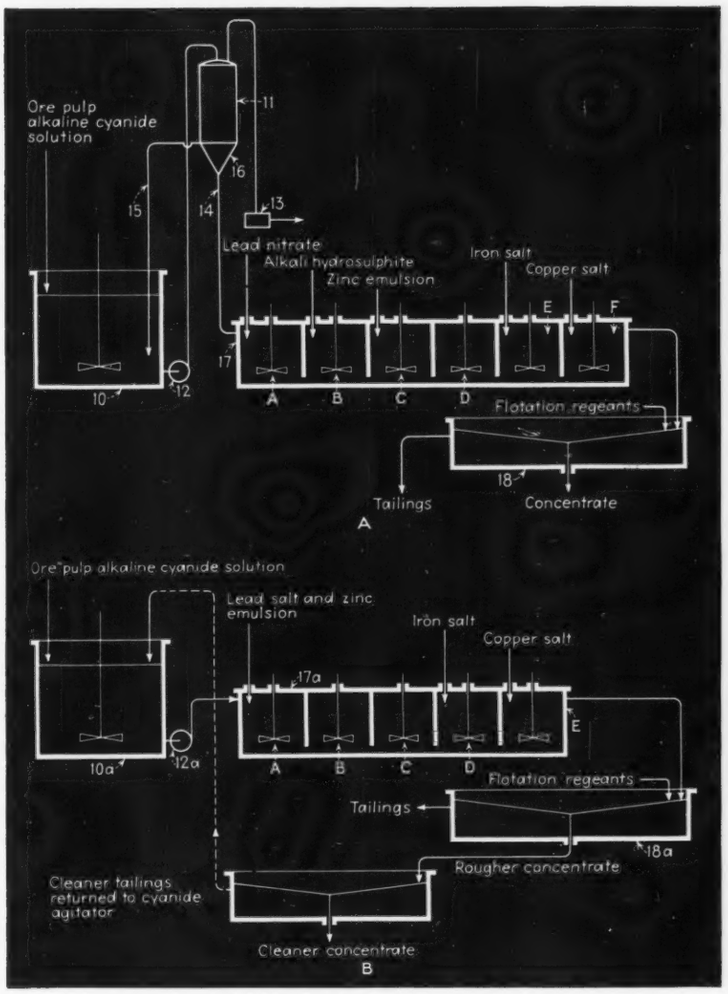

Fig. 3 . . . Flowsheet of the Mills-Crowe-Haun process. U. S. Patent 2,111,600, issued March 22, 1938, and assigned to the Merrill Company, San Francisco

due to the rapid advancement in flotation by the introduction of xanthates."

That further attention is being directed to the better treatment of gold-bearing ore containing carbonaceous or graphitic substances is shown in United States Patent 2,154,092, April 11, 1939, issued to John Edward Hunt, of Jackson, Calif. In his 7 claims, numbers 4, 6, and 7 read as follows:

"4. In the process of concentrating ores containing carbonaceous substances associated with gangue minerals by flotation, the steps which comprise treating ore pulp containing particles coated with carbonaceous material with sulphur dioxide, and subjecting said pulp to froth flotation concentration.

"6. In the process of concentrating ores containing gangue having carbonaceous material thereon by flotation, the steps which comprise treating carbonaceous ore pulp with a reducing gas sufficiently to decrease materially the tendency of the gangue to float, and subjecting said pulp to froth flotation concentration.

"7. The process which comprises concentrating metallic ore containing gangue having carbonaceous material thereon by froth flotation, treating the metal concentrate therefrom with a reducing gas and subjecting it to another flotation concentration."

Re-floating, grinding of the concentrate and cyaniding it is proposed, and roasting the new flotation concentrate before cyanidation would provide the sulphur dioxide gas needed for the process described.

Experiments in Russia—Some attention has been given in Russia to charcoal and to charcoal precipitation of gold. According to S. M. Yasukevich in *Tsvetnye Metal,* No. 6, 1939, the best results in the activation of birch or pine charcoal were obtained by treatment in an atmosphere of CO_2 for 4 hours at 800 deg. C. The product was then tried on gold and silver-bearing cyanide solutions. Minus 100- to 200-mesh charcoal was found to be most effective. Best results were obtained at 5 to 20 deg. C. Almost complete adsorption of the gold was obtained. A study of the floatability of activated charcoal showed the more adsorbent the charcoal the more difficult it is to float. Kerosene, pine tar, and shale oil were found to be satisfactory reagents, but consumption was high. Extraction (90 to 95 per cent obtained) decreases with increasing liquid: solid ratio, but purity of the concentrate increases. Neutral or acid flotation pulp produces the best results. In the treatment of gold-charcoal concentrates, they are mixed with water (50 per cent), briqueted, and burned, and the product is melted.

Precipitation of Gold on Zinc Dust and Floating the Precipitate—With reference to mention of the possible use of finely divided zinc in the Edquist specification, United States Patent 2,111,600 was issued March 22, 1938, to Louis D. Mills, Thomas B. Crowe, and Joye C. Haun, and assigned to the Merrill Company, San Francisco, for the following invention:

The comminuted ore or tailing is contacted with alkaline cyanide solution to dissolve the readily soluble metals. The pulp is conditioned for precipitation by removing or inhibiting any free oxygen present, which may be effected by adding an alkali hydrosulphite or by mechanical deaeration followed by the chemical addition. The oxygen-free alkaline pulp is then completely precipitated by the introduction of a suitable precipitant, such as zinc dust. To accelerate and render the precipitation more complete, a soluble lead salt as lead nitrate may be added to the pulp either prior to or simultaneously with the introduction of the zinc precipitant. Chemical deoxidation and precipitation are accompanied by vigorous mechanical agitation which preclude re-absorption of atmospheric oxygen, as in enclosed tanks. The pulp is then conditioned for flotation by converting cyanogen solvents present into compounds which are non-solvents for the precipitated metals. This can be accomplished by the addition of a suitable salt of a heavy metal, such as copper sulphate. The stabilized pulp is then subjected to flotation for recovery of the precipitated metals and any other precious-metal bearing minerals which may be present. Conventional flotation reagents may be employed, as potassium amyl xanthate, cresylic acid, and pine oil.

In a modification of the foregoing, particularly where the predominant precious metal is silver, the alkaline pulp, after dissolution of the metals, may contain only relatively small amounts of residual free oxygen. Then, the mechanical or chemical deoxidation (or both) of the pulp may be dispensed with. A lead salt, zinc dust, iron salt, copper salt, and flotation reagents are added and agitated in closed tanks, as previously explained. The rougher flotation concentrate is re-floated, the cleaner concentrate going to treatment for recovery of its precious metals and the cleaner tailing returning to the cyanide agitator. Fig. 3 shows the patented procedure.

Aerial Photography Grows Up

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Improved equipment and technique have enhanced its value to the geologist and engineer

AËRIAL PHOTOGRAPHY, having reached its mature age of 25 years or more, has earned its reputation as being an exact and practical science. Yet it is not a science sufficient unto itself; it is of necessity an allied science. It walks hand in hand with industry and commerce and the professions. The oil industry makes use of it in the laying of pipe lines; the real-estate operator makes use of it in the laying out of a housing project; the mining geologist may well say, along with John Milton, "But now my task is smoothly done: I can fly. . . ." But aërial photography was not always the exact science that it is today. For the sake of curiosity, let us go back to its beginnings. Then its equipment was poor and its uses were few. In fact, it was in that stage of its development a "war baby."

Captain "Bob" A. Smith, when a lieutenant in the R.A.F., flew, with a co-pilot, close enough above a German airdrome to drop footballs on it. This was done as a lark, but when he told his commanding officer of the exploit, he was told to fly back and close enough above the airdrome to take pictures of it. That exploit, Captain Smith told us, was the beginning of a very unpleasant life. Others were selected to perform similar feats, and thus was launched the unhappy duty of aërially photographing the results of trench straffing, the recording of bomb hits, and the movements of German troops. Ordinary hand cameras common to amateurs of the day were used. It was a picturesque job, but one requiring all the qualities of a man. Even so was it in the immediate after-war years, when planes and photographic equipment were not much improved. The story is told of how a photographer and pilot, attempting to map a section of the Everglades, fell on the banks of a stream. Theirs was a gruesome welcome; their first thought had been to get out and repair the broken water jacket, but they were dissuaded when they saw the alligators and rattlers stretched out for a Floridan sunning. It was four days or more before they were rescued. Eventually improvements in both planes and photographic equipment made it possible to start aërial photography along scientific paths. For these improvements much is owed to Sherman M. Fairchild.

Though neither a professional pilot nor a photographer beyond the rank of amateur, he knew the problems confronting aërial picture takers, and had an enthusiasm matching theirs, which urged him to set about helping the infant business along. Thus it is to him, largely, that we must give thanks for the equipment which makes our present-day photographic survey possible. First, he foresaw the need for: good visibility for the pilot so that he might closely follow the ground features directly beneath the plane and also be able to see well ahead so as to keep lined up on prominent landmarks; an airplane capable of operating at high altitudes; that is, it should be equipped with sufficient excess horsepower to provide a flying speed greater than the velocity of any wind that might be encountered; a ship of high lift characteristics, enabling it to reach altitude in a short time; and many other features that today would sound too ridiculous to mention. To embody the many characteristics into one ship, he had to have the plane constructed by his own staff. It is interesting to note that this became the first cabin plane in the United States that permitted the pilot to be inside the cabin and up front. It also had the advantages of folding wings, which made it easy to store in the small hangars then usually to be found on country air fields, and also to be transported on shipboard. But his interest did not stop there. His enthusiasm for the future of the profession spurred him on to the building up of an association of aviation manufacturing organizations from which have come the great majority of the aërial cameras and scientific equipment now being used by other aërial photography companies, the United States Government, and the governments of many foreign countries.

The world's largest aërial camera known to me is the Nine-Lens camera. It was designed for the United States Coast and Geodetic Survey by Lieutenant-Commander O. S. Reading in coöperation with Fairchild engineers and was intended primarily for the mapping of coast lines and large tracts of terrain over which ground control points are widely scattered. Its principal advantages are its tremendous area coverage, the minimum of ground control needed, and the higher accuracy of the resulting mosaics or maps. Nine separate 8¼-in. focal-length lenses provide nine separate exposures simultaneously on a single roll of film 200 ft. long, which is sufficient for 100 composite photographs 23x23 in. in size. Each composite negative thus obtained is later rectified in a special transforming printer designed for use with the Nine-Lens camera to provide a single photographic print 35 in. square. A single photograph taken at a scale of 1:20,000 will cover approximately 120 sq.mi. Only one lens of this camera photographs directly, the other eight photographing the images of the ground as reflected by stainless-steel mirrors ingeniously arranged on a stainless-steel frame of unusual design. With its operating accessories, the camera weighs 300 lb.

In addition to this so unusual instrument is the Ten-Lens camera, which consists of two Five-Lens cameras supported in a special tandem mount with one camera unit fixed at an angle of 45 deg. to the other. The peculiar method of mounting these units provides a solid composite photograph, octagonal in shape, measuring 32 in. across. An area of approximately 225 sq.mi. is included in a single composite photograph when taken with this camera at an altitude of 20,000 ft. Then there is the Stereocomparagraph, a simple plotting instrument for compiling vertical data such as form lines, profiles, slopes, and similar characteristics, as well as planimetric details directly from overlapping vertical aërial prints. There is the apparatus for making night aërial pictures which

San Andreas fault in vicinity of San Bernardino, Calif., as photographed from the air. Courtesy of Fairchild Aerial Surveys, Inc.

was designed originally for the United States Army Air Corps. And there is the Photogrammetric camera, a wide-angle precision camera especially designed to produce photograps for extremely accurate mapping work and built to conform with the rigid specifications laid down by the many United States Government departments and the American Society of Photogrammetry. But let us consider the general-purpose camera and its operation. Too, let us consider the taking of the aërial picture and the making of the mosaics. This, that we may better appreciate the need for and use of the Solarnavigator and the Stereoplanigraph.

The general-purpose camera may be used for the taking of either oblique or vertical pictures. We will consider the taking of vertical pictures. In stepping into the plane, we see back of the control cockpit a seat over a storage battery which is fed by a generator attached to the engine. In front of the seat is a direct view finder aimed vertically downward through an opening in the cabin floor. In front of the view finder is the camera itself. Equipped with an electric motor and a spirit level, it is suspended from a gimbal mount which permits it to be swung in any direction. The camera, too, is aimed vertically downward through another opening in the cabin floor. Near the photographer's seat, within handy reach, are a spare camera magazine, ammeter, and voltmeter and the intervalometer which controls the time interval between exposures. Both magazines, the spare and that attached to the camera, hold a roll of film containing 110 exposures. The magazines may be changed in flight in from 15 to 20 sec. While the plane is gaining altitude during its approach to the terrain to be surveyed, both pilot and photographer study United States Geological Survey maps on which have been drawn guide-flight lines. It is obvious that both pilot and photographer must work in accurate unison, since, when the plane is over the area to be mapped, the photographer presses a button which flashes a red bulb on the pilot's control board, which tells him that the first of the pictures is about to be taken. This red bulb is flashed a few seconds before each exposure as a warning to the pilot to hold the plane steadily and directly on its course.

The altitude at which the plane must be flown is determined by the scale at which the area is to be mapped and the focal length of the lens which that particular scale demands. For example, a scale of 1,000 ft., taken with a lens of 10-in. focal length, will demand a flight altitude of 10,000 ft. above the terrain—not above sea level. This altitude is determined by multiplying the scale, 1,000 ft., by the focal length of the lens, 10 in. This particular scale will, in a single exposure, photograph a ground width of approximately 10,000 ft. But only about 2,500 ft. each side of the exposured center is guaranteed to be accurate. This because of the plane's divergence from its true flight as a result of cross winds. Since each exposure overlaps the previous one and is in turn overlapped by the following, the net effective area photographed is reduced to about one-fifth of the whole. For that reason, the photographer must time his sequences so that they overlap shingle-wise by about 60 per cent, and the pilot must plot his course so that the exposed strip of terrain will overlap by about 50 per cent. This overlap is necessary for the purposes of accurate mapping, as each photograph shows in addition to the objects directly beneath the camera the objects which were directly beneath the camera during the previous exposure and will be directly beneath the camera during the next. It is by this overlapping method that the displacement due to ground elevations at the edges of the photographs may be determined and corrected. When determined and cor-

rected, a stereoscopic study of the terrain is possible which transforms the prints into three-dimensional visual plastic models.

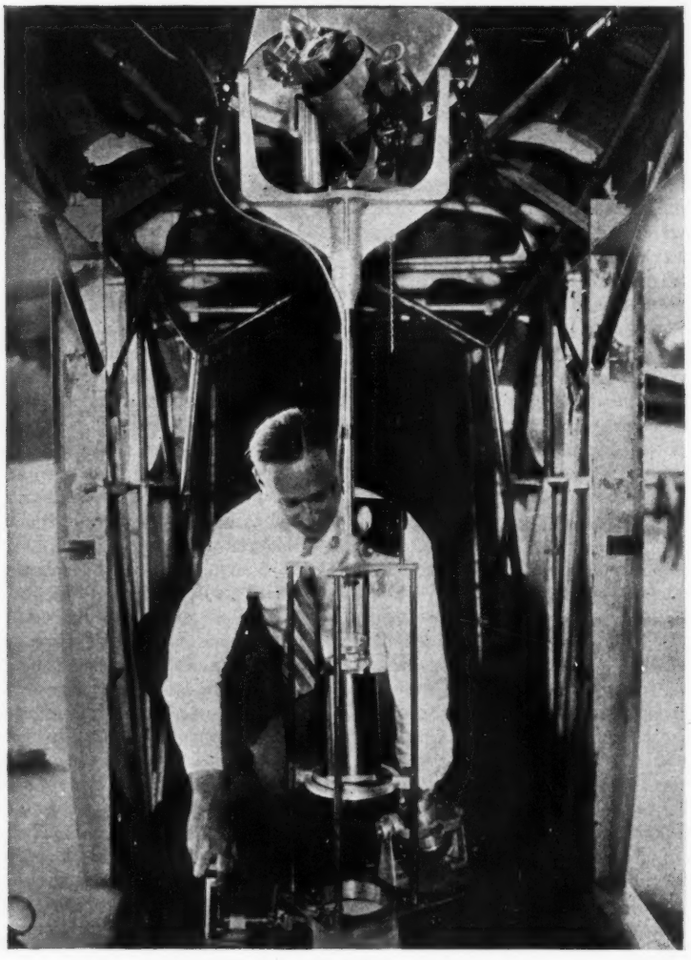
On a set of developed contact prints, scale ratio is carefully figured by checking comparable distances on the prints with known distances on the actual terrain. Inaccuracies are thus determined. Each print is then projected to a common accurate scale. On a composite board are drawn pencil control lines to the desired scale of the map, the control being triangulation points obtained from field notes, road maps, and complementary features. The corrected prints are then cut on lines determined by the physical type of terrain, such as streams, roads, and acreage rectangles. These cut prints are then cemented onto the composite board over the corresponding control lines. This master mosaic is then copied and rephotographed, and prints, made from the copy negatives, are matched together to make the complete mosaic. A client, however, does not receive the original of this complete mosaic; he will receive copy prints which are photographs of the master mosaic, each about 20x24 in.

It is a fact that aërial maps are common tools to geologists. The average geologist, however, goes about reading his aërial maps much as a puzzle addict puts together the intricate pieces of the design. Once the design becomes known to the latter, the remaining pieces quickly fall into their respective places. So does the geologist work out his pattern from the study of his maps. He can see, for instance, that a certain type of white line may suggest a vein of quartz. Then he may notice that there is a change in the photographic tone of vegetation that reflects two kinds of soil on opposite sides of a contact. He learns that, by the erosion pattern, he can distinguish the softer formations from the harder. Thus, bit by bit, he puts together the pieces of his puzzle, which, because of his practical ground experience, becomes an intelligible picture. Yet the photographic evidence, from which he must make his interpretations, varies with bewildering profusion. However, of one thing he is certain: the airplane, with its photographic mapping equipment, is a superb reconnaissance tool, awaiting only his ingenuity in correlating the pictures with the ground.

Generally speaking, three classifications govern the application of aërial mapping to mining. These are aërial geology, detailed geology, and operations and development. Yet whatever the classification under which a particular mapping project falls, there is always the important, in fact vital, problem of whether or not the photographer and pilot can do the job. In mapping large areas, the ability of the airplane to perform at high altitudes and to fly successively the overlapping strips of terrain is of paramount importance. The airplane should be capable of maintaining sustained flight at 25,000 ft. This altitude means supercharged motors and supplies of oxygen for the personnel. The reduced air pressure at high altitudes has placed 25,000 ft. as the safe limit of human endurance for day-in and day-out flying. Adding to this the annoying problems involved in the mapping of large areas of which no maps of any sort exist, or of which any existing maps are most inaccurate, navigation is of major importance. Even top-notch photographic plane pilots are provedly unable to fly strips of from 60 to 120 miles in length sufficiently parallel to each other so that no gaps are left between the strips and still maintain the required overlap. It is easily understood that it must be difficult to keep a plane flying along an imaginary line when the plane is constantly changing its direction to compensate for variations in wind direction and velocity. The solar-navigator was designed by Leon T. Eliel to solve this problem.

This is a device consisting of a drift indicator in the floor of the plane, stabilized by a gyroscope to offset the tendency of ground images to meander over the drift field as the airplane rolls. The drift indicator is suspended from a sun compass attached to the ceiling of the plane's cabin. This compass registers by remote control on a galvanometer attached to the pilot's control board. The desired course is set between the direction of the drift lines of the drift indicator and the axis of the sun compass. This combination registers on the pilot's control board when he departs from his true direction. Thus it automatically solves the problem of varying winds and drifts, and the pilot merely has to fly his plane by following the galvanometer hand on his instrument panel. In addition, the instrument operates automatically, being dependent only upon the careful adjustment by the navigator, back in the cabin, of the drift indicator so that the image of objects on the ground glass moves accurately along the drift lines. The instrument

The solar-navigator installed on a plane. It was designed to solve the problem of keeping a ship on an imaginary line when constantly changing direction to compensate for variations in wind direction and velocity. Courtesy of Fairchild Aerial Surveys, Inc.



A camera and the solar-navigator installed in a plane. Courtesy of Fairchild Aerial Surveys, Inc.

will fly an airplane along any predetermined course to an accuracy of one quarter degree.

It might seem strange to many that, when looking at an aërial picture, any reliable contour map could be made from it. Yet, the principles of photogrammetry are simple. Any two overlapping aërial photographs, taken successively as the airplane flies along, and having a common area, can be viewed in relief by the use of a stereoscope so that one eye sees one picture and the other eye the other picture. One thus gets the same ground view that a giant would get were he tall enough to have his two eyes in the same position at which the pictures were taken. He would get the same sense of relief of the earth itself as we get looking at a miniature model held a foot from our eyes. Our eyes follow the same angular paths that two transits would follow were they placed in the position at which each picture was exposed. As the transits would have to converge on a high object, so our eyes would have to converge to meld the two images of a high object; as the transits would diverge to a low point, so our eyes must diverge to meld two lower images. The amount of this convergence and divergence is an exact mathematical quantity.

The Stereoplanigraph (of which, to my knowledge, there is but one in this country), from which we today plot contour maps from aërial photographs, replaces the two pictures in miniature. The exact angle and elevation of the images on each picture are reproduced at the small scale of the stereoscopic model. An index or reference mark is provided, which is so mechanically articulated by the machine that it can only appear to move in a single horizontal plane. It appears to float in the air, if it is over a canyon, or to bury itself in the ground, if above a higher surface. Thus the operator is able to tell exactly when the index mark is in precise contact with the ground surface. By the operation of two hand wheels, he causes this index mark to trace off exactly the ground surfaces of the plastic image and, as the machine draws on a piece of paper, forms a map.

This machine can draw maps to any desired degree of precision. They can be made at scales as large as one inch to twenty feet or as small as one inch to two miles.

The details thus far given have applied only to vertical aërial pictures. But they may also apply to oblique pictures. It is claimed by some authorities that aërial contour maps made from oblique pictures are equally as accurate, and far more economical. O. M. Miller is said to have invented machines called a "photogonimeter" and a "single eye-piece plotter" through the use of which he draws accurate contour maps from oblique pictures taken over exceedingly rough terrain. However, other aërial survey engineers have made precise contour maps from oblique photographs by the use of grids and the application of the plotted templet method. If, as it is claimed, contour maps from oblique pictures prove equally as accurate and far less expensive, one should not be surprised to learn of improvements being made in the vertical-picture method which also will prove less expensive.

As costs have been mentioned, it is only fair to give them their due. The cost of any aërial map is dependent on many factors. For example, distance away from an operating base, weather factors, the scale at which the pictures are required, the precision at which the map is to be made, and many, many others. In other words, one cannot generalize, because seldom are there two projects with sufficiently similar conditions to justify even a rough comparison. To close with an encouraging statement, maps have been made in the past which have ranged in price from $2 to $50,000 a square mile. Yet it is not a difficult matter to estimate costs for a definite project.

Aërial photography has indeed grown up. To quote Leon T. Eliel: "If one learned something about aërial mapping six, seven, even eight years ago, he should be brought up to date, since aërial mapping even then was in its swaddling clothes."

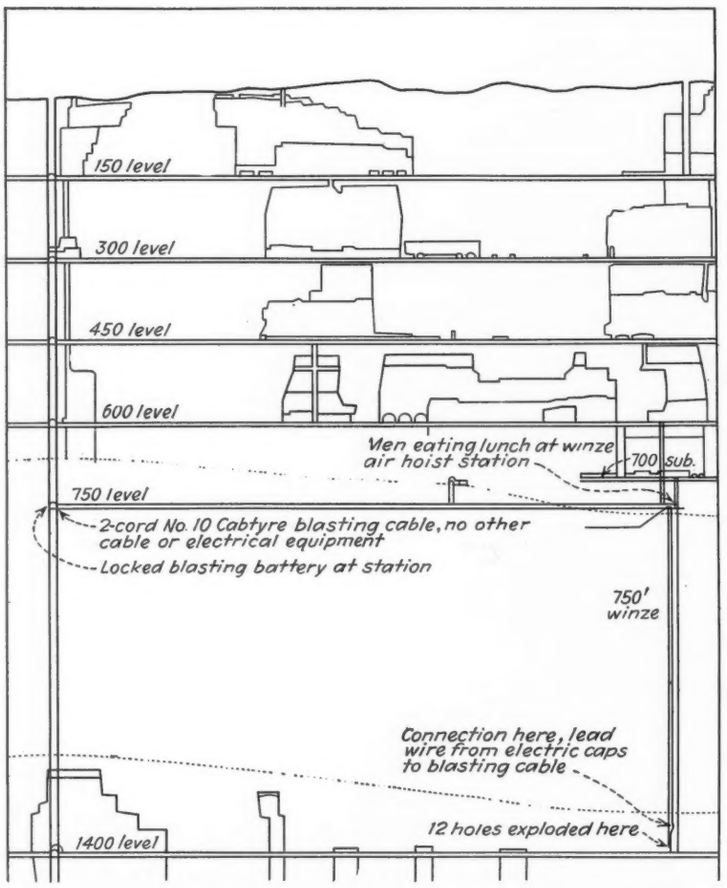
▼ ▼ ▼

Rand Gold Output Sets Record

GOLD PRODUCTION on the Rand in December was 1,072,380 oz., making the total production for 1939 12,495,111 oz., valued at approximately £93,179,300. The increase in output, compared with that for 1938, therefore, was 656,034 fine ounces, representing nearly £8,806,600. The total tonnage milled during December 1939 was 4,968,800, and the working costs were 19/10d. per ton milled. The value of gold produced in the Union of South Africa rose from £84,019,909, in 1938, to £96,326,414 during 1939. The production itself rose by 662,715 fine ounces to 12,819,344.

Lightning and the Premature Firing Of Electrical Blasts

A recent occurrence in western Ontario invites a study of such happenings


150 level
300 level
450 level
600 level
Men eating lunch at winze air hoist station
700 sub.
750 level
2-cord No. 10 Cabtyre blasting cable, no other cable or electrical equipment
Locked blasting battery at station
750' winze
Connection here, lead wire from electric caps to blasting cable
12 holes exploded here
1400 level

A vertical projection of Northern Empire workings, illustrating the relationship of the winze, at the bottom of which the blast occurred, to the working shaft

WHAT might easily have been a disastrous blasting accident occurred at the Northern Empire mine, in the Thunder Bay district, western Ontario, on the night of Sept. 2, 1939, during a severe electrical storm. The circumstances suggest that it was directly due to lightning.

The incident, as described for the *E.&M.J.* by company executives, occurred at the bottom of a winze that had recently been sunk to connect the 750 level to the next lower level, the 1,400, the reason for the vertical interval being that a thick, post-mineral diabase sill blots out the vein throughout this distance. During the work of sinking, the blasting had been done with electric detonators, with the delays customarily used, the detonator wires being connected with a lead wire to a two-cord No. 10 "Cabtyre" blasting cable which extended to the collar of the winze and out through the 1,200-ft. lateral, driven through the diabase and serving to connect the winze and the 750-level station of the shaft. A hand-operated blasting battery was maintained at the station and kept locked, the key being in possession of the leader of the shaft crew. The hoist on the winze was air-driven, and there was no power cable, light wire, or electrical connection of any kind between the shaft and the winze collar, except the blasting cable.

On the evening of Sept. 2, the men of the night crew were working in the bottom of the winze, which had broken through to the 1,400 level, and were slashing within one round of the level. They had drilled a bench round of 12 holes and had connected them in series with electric caps ranging from 0 to 12 delays. The two-cord blasting cable came within 50 ft. of the round, so lead wire was used for this distance. The crew had come up to the 750-ft. level for lunch, after connecting up. At 11.55 p.m., while eating, they heard 12 holes fire and thought that it must have been their round. They had tested the circuit and found it closed after coming up to the 750 level. After hearing the shots they immediately tested again and found that the circuit was open. This convinced them that it was their round that had gone off. The battery was at the station 1,200 ft. from the winze at this time.

This winze had been put down for ventilation purposes and has a strong down draft so that the men could go down 15 minutes after a blast. Frank Miller, shaft leader, and Aarne Niemi, shaft man, on going down, discovered that all of the 12 holes had blasted. While coming up, they felt shocks from the wall plates and the bucket for a distance of 40 ft. up the winze. The shaft leader reported to the shift boss, J. Ramstad, and it was decided to stop all work in the winze until this accidental firing had been thoroughly investigated.

On the following morning, the electrician, I. A. Kavela, and F. Matson made an inspection, going to the top of the winze on the 750-ft. level. There, they attested, they found the main blasting cable lying "with the two wires apart on an empty cable reel in the winze station." They also reported that no evidence of "any trace of electricity" was found in the station. The electrical apparatus and cables in the main shaft were tested for insulation and grounds, and everything was found in order.

During the storm, at midnight, the electrician had been called out because of signal trouble and had found evidence that lightning had entered the apparatus, damaging the hooter-coil insulation. He noted also a failure of the mine power, lasting a few minutes, at the time.

From the evidence the management inclines to the opinion that the flow of electricity through the ground, perhaps influenced to some extent by the diabase sill, induced sufficient current in the insulated blasting cable to explode the caps.

In this connection it is interesting to refer to the May, 1939, issue of the *Explosives Bulletin* (received through the courtesy of the Northern Empire management), issued by Canadian Industries, Ltd., Montreal, wherein is discussed a brief study made of instances of the premature firing of electrical blasts in mine shafts in northern Ontario in recent years. In each of three such cases cited a lightning bolt had struck on the surface near by immediately prior to the blast, the lead wires had not been connected to the charge, and the hoisting rope, with bucket attached, was in or near the bottom. The writer of the bulletin says he is led to believe that these accidents "were most probably caused by the nearness of the hoisting rope to the blasting circuit, coincident

with a near-by stroke of lightning on surface"; also that the lightning "may not necessarily have struck the rope itself or even the shafthouse. . . . It is reasonable to conjecture that some portion of the discharge would travel along the moist surface of the ground and enter the hoisting rope . . . finally selecting as a portion of its channel to ground, all or part of the blasting cap circuit." Other possibilities also are considered, among them that an electric charge was induced in the rope during the storm and was released when the lightning struck, selecting the blasting circuit as part of its path; that a portion of the electrical discharge may have entered the pipe lines, directly or indirectly; and also that an induced charge may have been induced in the lead wires attached to the bulkhead and, on release, may have short-circuited to the blasting cap circuit across wet timber.

This study of premature blasts likewise considers the possibility of their being caused by stray current from various sources entering the blasting circuit. An instance is related where in a base-metal mine it was found that the solid sulphide orebody carried a measurable electrical potential and that at various points electric blasting caps could be fired by connecting them from the ore zone to the ground. It was concluded in this case that the potential was developed by the ore zone itself acting as a cell and augmented by leakage from the power system.

As precaution, the bulletin suggests, with respect to safeguarding against stray current, that (1) the blasting circuit and the lead wires from it should be prevented from contacting, directly or indirectly, all lines carrying any electrical current or which might act as a vehicle for stray current, such as pipe lines, rails, and hoisting ropes; and (2) that the lead wires should be broken and short-circuited at a safe distance from the charges.

To avoid premature blasts that might be caused by lightning, the bulletin suggests that, in addition to the precautions against stray current mentioned in the foregoing, it should be made a hard and fast rule, whether on surface or underground, never to conduct electric-blasting operations during an electrical storm or if one appears imminent.

These suggestions will recall to some the blasting procedure devised by the late H. J. Clement, when superintendent of the Porcupine Paymaster, in Ontario, in 1928, in which mine all blasting was done electrically (described in *E.&M.J.*, Nov. 10, 1928). Special precautions were devised, so far as possible, to prevent any current from whatever source, especially lightning, from reaching the charge until the moment for blasting arrived.

U. S. G. S. Program Last Year Marked By Strategic Mineral Studies

Twenty-four projects were undertaken, including investigations of deposits of eight commodities on the Government's list

THE outstanding feature of the United States Geological Survey's work in mining geology during 1939 was a systematic investigation of strategic minerals. This program, begun in 1938 under a P.W.A. grant, was continued under Congressional authorization (Public—No. 117—76th Congress) for investigating domestic deposits during the four fiscal years 1940-1943. Investigations are being restricted to deposits of eight metals, aluminum, antimony, chromium, manganese, mercury, nickel, tin, and tungsten, and to deposits of mica. The investigation calls not only for geologic study but for prospecting and sampling, which latter are being done by the Bureau of Mines in places selected by the Survey geologists. D. F. Hewett was in general charge of the Survey's work on strategic minerals in the United States and P. S. Smith was in charge of work in Alaska. Hewett was assisted by J. T. Pardee in the Northwest, H. G. Ferguson in Nevada; also by T. B. Nolan, who had charge of investigations of tungsten deposits; C. P. Ross, quicksilver deposits; and W. D. Johnston, investigating chromium deposits.

Twenty-four projects, some of them continuations of P.W.A. projects, were undertaken, including studies of antimony deposits in Idaho, Nevada, and California; chromite deposits in southwestern and central Oregon, Stillwater, Mont., and in California; manganese deposits in the Olympic Mountains, Washington, Philipsburg, and Butte, Mont., and in Nevada, New Mexico, and Arkansas; nickel in Alaska and Nevada; quicksilver in California, Oregon, Nevada, and Arizona; mica in North Carolina; tin in Alaska, South Dakota, Nevada, New Mexico, the Carolinas, and Virginia; and tungsten at Mill City and other places in Nevada, and at Bishop and Atolia, Calif. Other projects will be started in the spring of 1940.

Under regular appropriations, ten projects were continued or initiated in cooperation with the States of Colorado, Idaho, and Oregon, and non-cooperative projects were in progress in several States.

In Colorado W. S. Burbank continued studies of the Uncomphagre, or Ouray, district. His report on structural control of ore deposition in that district is in press. A. H. Koschmann, in continuing studies at Cripple Creek, gathered critical evidence that throws new light on the origin of the Cripple Creek crater and the structural control of ore deposition. A progress report on his work is expected soon. E. N. Goddard's work on the Gold Hill district was completed and his preliminary report is nearing completion. Q. D. Singewald completed a report on placer deposits and the outlook for commercial lode deposits in the Beaver-Tarryall district, and extended his field work to cover the area between the Tarryall and Breckenridge districts. B. S. Butler and R. P. Fischer began a detailed study of vanadium-uranium deposits occurring in the vicinity of Uravan.

In Idaho, S. R. Capps continued studies of placer deposits and completed a report on gold placers of the Secesh Basin, Idaho County, which is to be published by the Idaho Bureau of Mines and Geology. R. S. Cannon continued detailed studies of the Seven Devils region.

In Oregon F. G. Wells did areal mapping in the Grants Pass and Kerby quadrangles. His preliminary geologic map of the Medford quadrangle, with accompanying text, was recently published by the State Bureau.

In the Tri-State zinc and lead region a four-year field study was concluded by E. T. McKnight, who was assisted in 1938 and part of 1939 by R. P. Fischer. Mapping of complex geology in the Pearce and Benson quadrangles, Arizona, was continued by James Gilluly. New deep developments in the Mother Lode, in California, were studied by W. D. Johnston, Jr. New work in the Sonoma quadrangle was begun by H. G. Ferguson and others, and some work on a resurvey of the Eureka District, Nev., was done by T. B. Nolan, whose time was mainly taken with strategic mineral studies. Areas containing phosphate deposits and mineral fuels in Wyoming and Idaho were mapped by W. W. Rubey and L. S. Gardner, and studies of potash in Texas were continued by W. B. Lang.

In the southeastern States, iron deposits were studied by E. F. Burchard and T. G. Andrews in the Greasy Cove and Russellville districts, Alabama, and work in the Cartersville district of Georgia, was continued by T. L. Kesler.

Studies of mineral fuels were conducted in Kansas (in cooperation with the State Geological Survey), and also in California, Montana, New Mexico, Oklahoma, Utah, and Wyoming.

USEFUL OPERATING IDEAS

Metallizing Dredge Parts

A PUMP SHAFT used on a gold dredge and so worn that it was considered fit only to be scrapped was restored to good condition by metallizing, writes H. L. Beaver, Modesto, Calif. The work is shown in progress in the accompanying photograph. One bearing of the shaft and the packing gland surface have been sprayed and the other worn point is just reaching completion. The work is under way in the metallizing job shop of the Talbot Iron Works at Modesto, Calif., and for the Snelling Dredging Company at Snelling, Calif. This pump shaft is 2¼ in. in diameter and has two worn places 3½ in. long. Tufton steel wire was used on it. The wear amounted to over 120/1,000 in.

A similar job done for the same gold dredge was that of reconditioning a cable drum shaft 5 in. in diameter. The two bearing points were 5 in. long and were sprayed with Tufton steel wire and ground to finished size. The direct saving to the Snelling company is estimated at approximately $40 on both shafts. In addition there is the saving resulting from minimizing the operating delay. At no time, moreover, during repair, is the part heated to a warping or crystallizing point.

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For Inspecting Wire Rope

TO FACILITATE examining the conditions present among the interior strands of preformed wire rope, the flat marlinspike shown in the hand of Dan S. Goodbody, engineer of the American Concrete & Steel Pipe Company, has been developed by T. H. Gray of that organization (at the left). The device is made of manganese steel to resist nicking; has a handle 8 in. long by ½ in. in diameter, and a tapered piece 12 in. long which diminishes in width from ⅛ in. at the handle junction down to a sharp point at the upper end.

This company standardized on preformed wire rope for its field machinery in 1933, stating that its rope life was increased 33 per cent, with the additional benefit of easier handling due to the inertness of the preformed strands, absence of porcupining under breaks, and elimination of the necessity for seizing the ends when cut, in order to prevent fraying outward. In developing the device for inspecting strands on the inside of the rope, Mr. Gray stated that careful separation of the strands is necessary; but that with this precaution, the strands can be gently pried apart down to the wire rope core, and replaced for service without damaging the rope.

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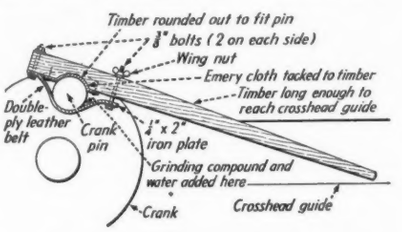
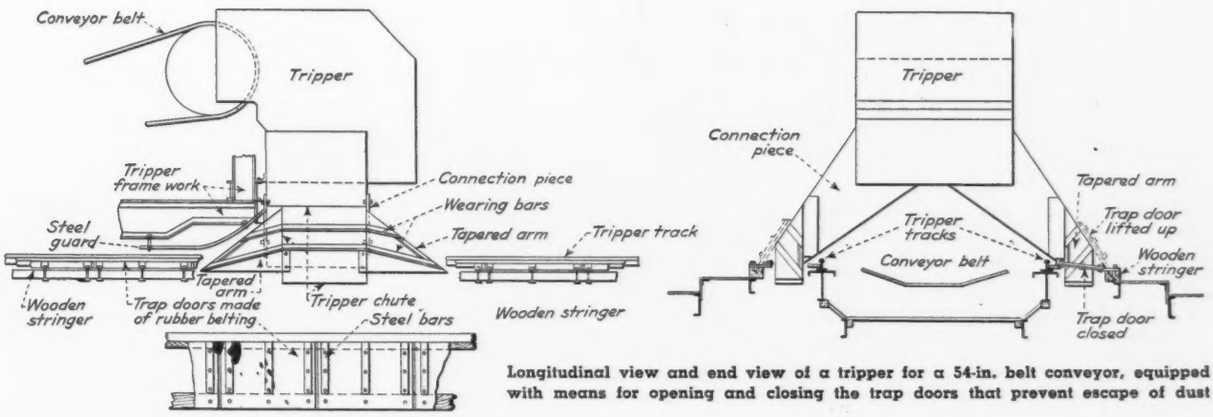
Air Compressor Repair

RECENTLY, a lengthy shutdown of an air compressor was averted by the Empire Star Mines Company, at Grass Valley, Calif., by use of the simple repair method here explained, writes Phil Keast, shop foreman. Failure of a crankpin bearing (burned out) resulted in a badly scored pin. The damaged


Timber rounded out to fit pin
⅜" bolts (2 on each side)
Wing nut
Emery cloth tacked to timber
Timber long enough to reach crosshead guide
Double-ply leather belt
Crank pin
4" x 2" iron plate
Grinding compound and water added here
Crank
Crosshead guide

bearing was rebabbitted immediately, and the crankpin smoothed up, but the repair proved unsatisfactory because the pin's uneven surface prevented normal bearing temperatures.

Reconditioning in a lathe, or installation of a new pin, was out of the question, but the problem was solved as follows. The connecting rod was removed and the crosshead pushed forward. Next, a short wooden board or beam, with a semicircular depression lined with emery cloth at one end, and a piece of double-ply leather belt held to the beam by four ⅜-in. bolts, was attached to the damaged crankpin. Two of these bolts contained wing nuts to facilitate adjustment of pressure. After a small amount of grinding compound had been placed on the belt surface, the compressor was started. It was shut down again after a 3- to 4-min. run. The emery cloth then was changed, more grinding compound added, and the procedure repeated. A perfect pin resulted after twelve runs. During each run water was added.



Longitudinal view and end view of a tripper for a 54-in. belt conveyor, equipped with means for opening and closing the trap doors that prevent escape of dust

Sealing Ore Bins Efficiently

AN EFFICIENT means for avoiding the escape of dust while the storage bins are being charged by the moving belt-conveyor tripper has been developed and patented by H. A. Nelson, of the concentrator staff of New Cornelia Branch, Phelps Dodge Corporation, Ajo, Ariz. Its features are shown diagrammatically in the sketches that appear above. Essentially, the device consists of an extension to the tripper chute, together with tapered arms on either side which automatically open and close the trap doors as the tripper moves along. As the chute is symmetrical about the center line, an attachment to both sides is needed, but where a single discharge tripper is employed, only one attachment is required.

The extension tripper chute is made of ¼-in. steel plate, welded, and bolted to the tripper chute proper. It contains ¼-in. wearing plate. Thin steel plate is used in the construction of the tapered arms or "plows." All are welded, and contain wearing bars made from 2x¾-in. steel which come in contact with the trap doors and prevent wear on the thin plate. The trap doors are made of flexible conveyor belting reinforced with light steel bars bolted to the belting to insure proper seating of the door. One end of the doors is hinged by bolts and nails to a wooden stringer and the other end is supported on a parallel wooden stringer.

Operation is relatively simple. The point of the tapered arm travels about 4 in. below the trap doors, and as the tripper moves along the forward arm comes in contact with the door and raises it to the position above the chute extension as shown, thus making a passage way for the ore from the chute to the bin. Then the door slides along the chute extension and rear taper arm back to a closed position. The guard, made of ¼-in. steel plate and bolted to the tripper framework, forces the open door under the driving mechanism.

The tripper illustrated is for a 54-in. belt, but the attachment described is applicable to any width and any style of tripper provided with side discharge chutes.

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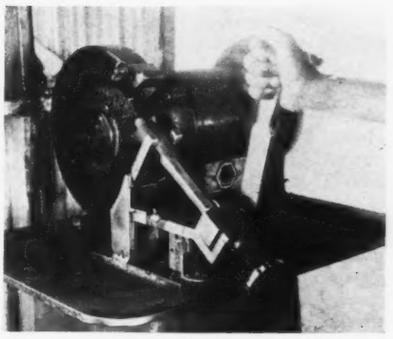
Jig for Grinding Jackhammer Bits

FAST AND UNIFORM grinding of jackhammer bits and other tools can be done with a power grinder, or even a hand grinder, by using a holding jig made as follows, according to Joseph C. Coyle, of Yuma, Ariz. The holding member, or carriage, of the jig is made from an 18-in. piece of ⅝x2½-in. black iron, with one end cut as shown in the photograph to admit a drill shank. Six inches of the forked end is bent upward and backward at an angle of 45 deg.; the rear end of the member is bent to form a 2-in. backing, parallel with it, so that a steel with the round collar resting in the fork will fit into a hole in a steel block resting against the backing. This block is 1½ in. square and 2½ in. long, with a round boss on the bottom face which rests in a slot in the carriage member.

The jig is seen set up with a buffing wheel in place



Adjustment for various lengths of steel is secured by a screw and wheel, threaded through the back of the carriage. To hold this adjustment a thin disk, with eight small holes, rests against the face of the wheel, in which are corresponding small metal balls, forced into the holes by tiny springs. A 2-in. section of coiled spring, welded between the disk and carriage, provides pressure.

Just in front of the backing block, a 4-in. piece of 2x⅝-in. iron is dowel-riveted to the bottom of the carriage, to move vertically in a slot through the base of the jig, and also through a slot in the grinder bench. Immediately back of it is a 1½x1½x2½-in. piece of angle which acts as a guide for the vertical member, and also holds a disk (bolted), over which a 2½-in. section of coiled spring fits, with a similar disk on the under side of the carriage holding the other end of the spring.

On the right side of the jig is an L-shaped handle of ½x1½-in. bar. This is bolted loosely to a short boss, which in turn is lug-bolted to the jig base. A short toggle, fastened by a washer and nut on the end of a bolt welded transversely across the carriage, is bolted loosely into the end of the handle. This provides a means of moving the carriage vertically as the work is carried on.

The base of the jig is a 9-in. section of ⅝x3½-in. black iron. Near the front end is brazed a vertical guide for the carriage, consisting of a 12-in. section of ½x2-in. black iron, bent to a U-shape, with front corners sloped sharply. With the front end of the carriage mortised in a quarter of an inch on each side, and a section of 1½-in. angle bolted to it and extending past the guides, a perfect vertical action is secured. A special grinding wheel is used when grinding jackhammer bits. (The photo shows a buffing wheel in place.)

PERSONAL ITEMS

Otto L. Yauch, formerly assistant chief engineer at Duluth for Pickands, Mather & Company, has become chief engineer.

Adolph Legsdin, for several years with the Solvay Process Company, Syracuse, N. Y., has accepted a position of associate professor of mineral dressing in the metallurgy department at the Missouri School of Mines and Metallurgy at Rolla, Mo., a division of the University of Missouri. Legsdin, born at Riga, Latvia, is a graduate of the Freiberg Mining Academy at Freiberg, Germany, holding two degrees from that institution and a Master's degree from the School of Mines at Columbia University.

ADOLPH LEGSDIN

John W. Finch, late Director United States Bureau of Mines, is established as a mining consultant, Room 1712, 25 Broadway, New York City.

Louis S. Cates, president and director of Phelps Dodge Corporation, has been elected to the board of trustees of Central Hanover Bank and Trust Company, New York.

W. F. Boericke, has renewed for another year his contract with the Philippine Bureau of Mines, in which he is chief of the valuation and mine investigation section.

Frank Ellis, principal of the Melbourne Technical College, left in December for the United States for a course of study.

E. Noel Goode, manager of the Chillagoe state smelting works, Queensland, has been reappointed for three years from August, 1939.

E. L. H. James has taken up the appointment of mine manager of Cuthbert's Misima Gold Mine, Ltd., Misima Island, Papua.

H. Bowley has been appointed government analyst and mineralogist in Western Australia.

A. T. Armstrong has been appointed chief inspector of mines in South Australia. He was formerly an inspector of mines and quarries.

Fred Searls, Jr., executive vice-president of the Newmont Mining Corporation, returned lately to his New York office after having inspected mines of his company at Grass Valley, Calif., and the enlarged plant of the Getchell Mine, Inc., in Nevada, in which Newmont holds a substantial interest.

E. E. Kimberly of the department of electrical engineering, Ohio State University, addressed a session of the recent annual meeting of the A.I.M.E., presenting some new ideas on teaching electrical engineering to students of mining and metallurgy.

E. E. KIMBERLY

J. B. Stott has been made a director of the Standard Cyaniding Company, operating a 600-ton cyanide mill in Pershing County, Nev. Scott was in charge of development of the property.

T. C. Denton, formerly on the staff of Noranda, is now engaged in developing a property in the Zeballos area on the west coast of Vancouver Island.

John D. Galloway, well-known Western Canada mining engineer, has been appointed permanent manager of the Monarch mine, at Field, B. C. Base Metals Mining Corporation, owners of the mine, have just recently reopened the base-metal property and milling commenced on Jan. 15.

Ernest N. Patty, general manager of Gold Placers, Inc., and Alluvial Gold, Inc., of Fairbanks, Alaska, has just completed a business trip through eastern Canada and stopped off for a day in New York recently while en route back to Alaska via Seattle.

S. F. V. Jackson, state mining engineer and chief inspector of mines in Queensland, retired at the end of December. He had been state mining engineer since 1911.

H. C. Parmelee, editor of *Engineering and Mining Journal,* has been elected president of the American Institute of the City of New York, a 112-year-old organization engaged in promoting a better understanding of the rôle of science and engineering in human affairs.

John E. Kerr, of International Nickel Company's development and research organization in New York, has been visiting mining properties in Cuba.

P. R. Hill, who has worked in Africa, Central America, and Ecuador for about 25 years, is now employed in the State of Guarico, Venezuela, and is living at the Hotel Jardin, Maracay, Venezuela.

E. R. Borcherdt, in charge of engineering research for Anaconda Copper Mining Company and its subsidiaries, left New York on March 2 for La Cananea, Sonora, by way of Tucson, Ariz., after spending several weeks in the East.

Stanley Reichert, mining engineer, formerly employed by the Embree Iron Company, Embreeville, Tenn., has recently left this company to become assistant geologist with the Tennessee Division of Geology in Nashville.

STANLEY REICHERT

John Carter Anderson has sold the control of the Big Bell lease and mill, which he has been operating at Chloride Cliff, Calif., and is resuming his practice as a consulting mining engineer, 633 Pacific Electric Building, Los Angeles, Calif.

Fred W. Snow, formerly manager of Consolidated Copper & Sulphur Company, Eustis, Quebec, is now manager of Mic-Mac Mines, Ltd., Canadian subsidiary of United States Smelting, Refining & Mining Company, Bonsquet Township, Quebec.

Milton Hoyt has gone to Pulacayo, Bolivia, with Cia. Huanchaca de Bolivia. He was formerly at McGill, Nev., with Nevada Consolidated Copper Company.

Leon W. Dupuy, author of "Sampling the Picacho" in *E.&M.J.*, January, 1940, has removed from Yuma, Ariz., to 6508 S. Halldale, Los Angeles, Calif.

Roy E. Thomas, formerly chief engineer for Giesche Spolka Akcyjna, at Katowice, Poland, is now with the Marcy mill division of the Mine & Smelter Supply Company at Denver, Colo.

Frederick L. Knouse, of San Francisco, has joined the staff of New Goldfields of Venezuela, Ltd. His address will be care of Señor J. Acquatella, Ciudad Bolívar, Venezuela.

H. F. Silva left Fiji early in January for Sydney, Australia, on vacation. He has been appointed metallurgist with the Austral New Zealand Mining Company, a subsidiary of Austral Malay Tin. He left Australia for Cromwell, New Zealand, early last month.

Roland D. Parks, recently assistant professor at the Michigan College of Mining and Technology, has been appointed assistant professor of geology at Massachusetts Institute of Technology. He will assume his duties at M.I.T. next fall.

John W. Rayl, a sophomore in mining geology at the School of Mines and Metallurgy at Rolla, Mo., has been granted scholarships for his junior and senior years by the Women's Auxiliary of the A.I.M.E.

E. J. Walli, formerly manager for Eldorado Gold Mines, Ltd., at Port Radium, Great Bear Lake, North West Territories, Canada, has gone to Kisumu, Kenya Colony, British East Africa, for Macalder Mines, Ltd.

Andrew B. Crichton, of Johnstown, Pa., a member of the A.I.M.E., and **George H. Richardson,** of Pittsburgh, a member of the American Society of Civil Engineers, have been appointed members of the State registration board of professional engineers of Pennsylvaina, to fill vacancies.

Dr. William A. Mudge has joined the technical staff of the technical service division of the International Nickel Company, in New York City. For the past seventeen years Dr. Mudge had been superintendent of research, superintendent of the refinery, and works metallurgist at the company's Huntington, W. Va., rolling mill. Before going to Huntington, he had spent two years at the company's Bayonne, N. J., plant, where he joined International Nickel in 1920.

JOHN VAN NOSTRAND DORR

John Van Nostrand Dorr, president of The Dorr Company, and associated companies in the United States and abroad, was one of nineteen inventors and research scientists to receive awards as National Modern Pioneers by the National Association of Manufacturers. Ceremonies were held in New York on Feb. 27 in commemoration of the 150th anniversary of the founding of the United States patent system. The award to Mr. Dorr was in recognition of his invention of machines and processes used in ore treatment and municipal sanitation.

L. P. Davidson is now associated with American Zinc, Lead and Smelting Company in the metallurgical department as assistant to **R. Ammon,** chief metallurgist, with headquarters at East St. Louis, Mo. Mr. Davidson was connected with Anaconda Copper Mining Company for 22 years, first in the research department at Anaconda and Great Falls, and later in the zinc plant at Great Falls. From 1926 to 1938 he was at Anaconda's Giesche Spolka Akcyjna, in Poland. For the last seven years of that period he was in charge of all metallurgical operations.

E. C. Bitzer, who recently returned from the Federated Malay States, is now mill superintendent for the London Mines & Milling Company, Alma, Colo.

W. B. Boggs, smelter superintendent, Noranda Mines, Ltd., calls attention to an error made by the printer in his article on "Copper Metallurgy" appearing in the February issue. In granulating slag at Noranda by "shotting" the current reverberatory slag, the molten slag is poured from the slag pots over wide cast alloy-steel launders into a large *concrete* tank filled with water, and not into a concentrate tank, as stated in the February issue.

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OBITUARY

Judson M. Stearns, of Eveleth, Minn., chief chemist for the Oliver Iron Mining Company, died Jan. 28 at the age of 66.

Earle D. Moiles, a graduate engineer of Stanford University and associated with the Nordstrom Valve Company, a subsidiary of the Pittsburgh Equitable Meter Company, died on Feb. 5.

Benjamin Harvey Bennetts, chairman of the North Pacific Section of the A.I.M.E., and widely known throughout the Pacific Northwest, died at Tacoma, Wash., on Feb. 12 at the age of 65.

Frederick G. Tryon, formerly in the United States Geological Survey and the Bureau of Mines, and later chief of the research division of the National Bituminous Coal Commission, died of pneumonia at Sibley hospital, Washington, D. C., on Feb. 15.

James F. McCarthy, president and general manager of Hecla Mining Company, died at Wallace, Idaho, on March 6, at the age of 73. He had been associated with the company since 1903. During the period of activity of the National Recovery Administration Mr. McCarthy was a member of the code authority on lead. He was a member of the Board of Regents of Idaho University.

Dr. Louis D. Ricketts, mining engineer, designer and constructor of smelters, and a director of Phelps Dodge, Anaconda, Inspiration Consolidated, and Greene Cananea, died in Los Angeles on March 4 at the age of 80. Dr. Ricketts was James Douglas Gold Medallist for 1940, a former president of the A.I.M.E., and a former Fellow and trustee of Princeton University.

Henry Livingstone Sulman died in England on Jan. 31 at the age of 79. Outstanding in his professional work were his achievements in froth flotation. Among the various patents in that art granted to him, either as sole patentee or jointly with others, was United States Patent No. 835,120, Nov. 6, 1906, issued to Sulman, Picard, and Ballot. This was the basic patent in agitation froth flotation that served as the basis of the extensive litigation that beset the mining industry in the United States from 1913 to 1922. Mr. Sulman had been active professionally in South Africa, Western Australia, Malaya, Canada, and Japan. He was a past president of the Institution of Mining and Metallurgy.

FRANCIS A. THOMPSON, president, Montana School of Mines, in genial mood, addressing a session of the annual meeting of the A.I.M.E. at the Faculty Club, Columbia University, New York. W. R. CHEDSEY, director, Missouri School of Mines and Metallurgy, complacently strokes his chin as Dr. Thompson discusses geological engineering.

Summary of the

MARKETS

WITH the undertone easy in the first half of February, continuing the downward movement that characterized the first month of the year, lower prices prevailed for copper, lead, and tin. Zinc resisted the declining tendency. Nervousness concerning the possible intensification of the European war this spring, which might lead to heavy consumption of non-ferrous metals, was largely responsible for improved buying that occurred in the second half of the month, strengthening prices. Nevertheless, monthly averages were lower and the *E.&M.J.* index of prices declined from 80.85 in January to 77.23 in February.

Early in the month domestic copper was under pressure because of freer offerings by sellers who had been enjoying good business in the export field, chiefly for Far Eastern account. Such business—Japan and Russia—did not loom large during February. The French Government closed a deal on Feb. 10 for 25,000 tons of near-by foreign copper at 11½c., f.a.s. Atlantic ports, which news, together with favorable domestic statistics, set off a heavy buying movement in the home market and raised the price from 11¼c., Valley, to 11½c. Sales for February totaled 147,197 tons, against 24,987 tons (revised) in January. Domestic stocks of refined copper declined from 159,485 tons at the end of December to 135,441 tons a month later. Export copper for near-by shipment settled at 11.70c., f.a.s., with May forward at 11.50c. Demand from abroad for forward metal was quiet.

Lead producers sold more than 40,000 tons of metal to domestic consumers before they raised the price one-quarter cent to 5¼c., New York, Feb. 28.

Zinc shared in the activity in the last week of the month and the prices moved up one-quarter cent on Prime Western.

Consumers were surprised when the Tin Committee reduced production quotas 40 per cent to 80 per cent of standard tonnages for the April-June period.

The Italo-Spanish Cartel fixed the price of foreign quicksilver at $205 per flask, c.i.f. New York, duty unpaid, thereby supporting the domestic market.

UNITED STATES MARKET

	Electrolytic Copper		Straits Tin	Lead		Zinc
1940	Domestic	Export	New York	New York	St. Louis	St. Louis
Feb.	(a) Refinery	(b) Refinery				
1	11.350	11,450	45.500	5.25	5.10	5.500
2	11.350	11.450	45.000	5.25	5.10	5.500
3	11.150	11.450	45.000	5.25	5.10	5.500
5	11.175	11.375	45.250	5.25	5.10	5.500
6	11.150	11.400	45.125	5.25	5.10	5.500
7	11.025	11.400	45.125	5.00	4.85	5.500
8	11.025	11.325	45.000	5.00	4.85	5.500
9	11.025	11.350	45.250	5.00	4.85	5.500
10	11.025	11.350	45.375	5.00	4.85	5.500
12	Holiday	11.200	Holiday	Holiday	Holiday	Holiday
13	11.025	11.325	45.875	5.00	4.85	5.500
14	11.025	11.300	45.625	5.00	4.85	5.500
15	11.025	11.350	45.125	5.00	4.85	5.500
16	11.025	11.400	45.125	5.00	4.85	5.500
17	11.025	11.425	45.125	5.00	4.85	5.500
19	11.025	11.450	45.375	5.00	4.85	5.500
20	11.050	11.450	46.125	5.00	4.85	5.500
21	11.275	11.625	46.325	5.00	4.85	5.500
22	Holiday	11.675	Holiday	Holiday	Holiday	Holiday
23	11.275	11.700	46.125	5.00	4.85	5.500
24	11.275	11.700	46.125	5.00	4.85	5.500
26	11.275	11.700	47.500	5.00	4.85	5.525
27	11.275	11.700	48.125	5.00	4.85	5.750
28	11.275	11.650	47.625	5.25	5.10	5.750
29	11.275	11.575	47.750	5.25	5.10	5.750
			AVERAGES FOR MONTH			
	11.148	11.471	45.851	5.076	4.926	5.534
Feb.			AVERAGES FOR WEEK			
7	11.200	11.421	45.167	5.208	5.058	5.500
14	11.025	11.308	45.425	5.000	4.850	5.500
21	11.071	11.450	45.533	5.000	4.850	5.500
28	11.275	11.688	47.100	5.050	4.900	5.605
Feb.			CALENDAR WEEK AVERAGES			
3	11.342	11.425	45.500	5.250	5.100	5.500
10	11.071	11.367	45.188	5.083	4.933	5.500
17	11.025	11.333	45.375	5.000	4.850	5.500
24	11.180	11.600	46.015	5.000	4.850	5.500

SILVER, GOLD, AND STERLING EXCHANGE

	Sterling Exchange		Silver		Gold	
1940		"90-day	(c)			(d) United
Feb.	"Checks"	demand"	New York	London	London	States
1	3.97500	3.93625	34.750	21.7500	168s	$35.00
2	3.95000	3.91000	34.750	21.8125	168s	35.00
3	3.97250	3.93250	(e)	(e)	(e)	35.00
5	3.98000	3.94125	34.750	21.7500	168s	35.00
6	3.98000	3.94000	34.750	21.6875	168s	35.00
7	3.97000	3.93125	34.750	21.5000	168s	35.00
8	3.97500	3.93750	34.750	21.5000	168s	35.00
9	3.96500	3.92750	34.750	21.2500	168s	35.00
10	3.97000	3.93125	(e)	(e)	(e)	35.00
12	Holiday	Holiday	Holiday	21.1875	168s	Holiday
13	3.96500	3.92750	34.750	21.1875	168s	35.00
14	3.94500	3.90875	34.750	20.8125	168s	35.00
15	3.94250	3.90750	34.750	20.7500	168s	35.00
16	3.95000	3.91500	34.750	20.7500	168s	35.00
17	3.95250	3.92000	(e)	(e)	(e)	35.00
19	3.94750	3.91250	34.750	20.7500	168s	35.00
20	3.94500	3.91000	34.750	20.6250	168s	35.00
21	3.95000	3.91625	34.750	20.3750	168s	35.00
22	Holiday	Holiday	Holiday	20.2500	168s	Holiday
23	3.95000	3.91750	34.750	20.1875	168s	35.00
24	3.95000	3.91875	(e)	(e)	(e)	35.00
26	3.94000	3.90875	34.750	20.1875	168s	35.00
27	3.94500	3.91500	34.750	20.3750	168s	35.00
28	3.94500	3.91250	34.750	20.4375	168s	35.00
29	3.93500	3.89875	34.750	20.5000	168s	35.00
			AVERAGES FOR MONTH			
	3.95652	.....	34.750	20.935	.....	35.00
Feb.			AVERAGES FOR WEEK			
7	3.97125	.....	34.750	.....	.....	. . .
14	3.96400	.....	34.750	.....	.....	.....
21	3.94792	.....	34.750	.....	.....	.....
28	3.94600	.....	34 750	.....	.....	.....

Calendar week averages; New York Silver; Feb. 3d, 34.750; 10th, 34.750; 17th, 34.750; 24th, 34.750.

(e) Not quoted (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout February.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940 Feb.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	Not quoted			236.5000	236.5000					Not quoted			
2	"	"		236.0000	236.0000					"	"		
5	"	"		236.5000	236.5000					"	"		
6	"	"		236.5000	236.2500					"	"		
7	"	"		238.0000	237.7500					"	"		
8	"	"		238.2500	238.0000					"	"		
9	"	"		238.5000	238.5000					"	"		
12	"	"		241.2500	241.0000					"	"		
13	"	"		242.2500	242.0000					"	"		
14	"	"		243.0000	242.7500					"	"		
15	"	"		241.2500	241.2500					"	"		
16	"	"		240.7500	240.5000					"	"		
19	"	"		242.0000	242.0000					"	"		
20	"	"		244.5000	244.2500					"	"		
21	"	"		246.5000	246.2500					"	"		
22	"	"		244.7500	244.7500					"	"		
23	"	"		245.5000	244.5000					"	"		
26	"	"		247.0000	246.5000					"	"		
27	"	"		254.5000	254.5000					"	"		
28	"	"		252.0000	252.0000					"	"		
29	"	"		254.0000	253.2500					"	"		
Average for month				242.833									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(March 1, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carolads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$40.00
Quicksilver, flask of 76 lb., 100 flasks or more	$178.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	$29.00@$30.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton	$55.00@$60.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 49c.
50 @ 52 per cent	(b) 49c.
44 @ 48 per cent	(b) 46c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$23.00
Domestic, 65 per cent and upward	(a)$22.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$37.50

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.60
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Berrylium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$100.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$2.00@$2.10

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$13.00@$14.00
Dalmatian, 50 @ 55 per cent	(a)$6.00@$7.00
French, 56 @ 59 per cent	(a)$7.00@$8.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$21.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	30@35c.
2 x 2 in	50@60c.
3 x 3 in	$1.25@$1.35
3 x 4 in	$1.50@$1.60
3 x 5 in	$1.75@$2.00
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	.....	20.280	.....	468.370	.....
April	42.750	.....	20.031	.....	467.778	.....
May	42.750	.....	20.123	.....	467.988	.....
June	41.955	.....	19.505	.....	468.137	.....
July	34.944	.....	16.952	.....	468.031	.....
August	35.951	.....	17.719	.....	460.383	.....
September	36.956	.....	22.178	.....	398.820	.....
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	.....	9.888	.....	42.938	.....	48.120	.....
April	10.265	.....	9.820	.....	42.031	.....	47.833	.....
May	9.833	.....	9.738	.....	41.656	.....	47.528	.....
June	9.775	.....	9.738	.....	41.986	.....	47.528	.....
July	9.976	.....	9.944	.....	42.899	.....	48.863	.....
August	10.261	.....	10.211	.....	44.685	.....	50.409	.....
September	11.635	.....	11.685	.....	(b)	.....	(b)	.....
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	.....	c42.689	.....	c48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	.....	4.674	.....	14.660	14.860	.....	.....
April	4.782	.....	4.632	.....	14.337	14.533	.....	.....
May	4.750	.....	4.600	.....	14.483	14.679	.....	.....
June	4.800	.....	4.650	.....	14.564	14.651	.....	.....
July	4.854	.....	4.704	.....	14.753	14.856	.....	.....
August	5.043	.....	4.893	.....	16.040	15.885	.....	.....
September	5.449	.....	5.299	.....	(a)	(a)	.....	.....
October	5.500	.....	5.350	.....	(a)	(a)	.....	.....
November	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	.....	b14.707	b14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits, New York		Standard, Spot, London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	.....	215.375	.....
April	47.160	.....	218.389	.....
May	49.031	.....	225.591	.....
June	48.853	.....	227.511	.....
July	48.548	.....	229.833	.....
August	48.793	.....	229.869	.....
September	64.588	.....	229.292	.....
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50,323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	( )
March	4.500	.....	13.728	13.961	.....	.....
April	4.500	.....	13.443	13.637	.....	.....
May	4.500	.....	13.717	13.938	.....	.....
June	4.500	.....	14.023	14.223	.....	.....
July	4.516	.....	14.235	14.435	.....	.....
August	4.719	.....	14.628	14.761	.....	.....
September	6.104	.....	(a)	(a)	.....	.....
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b)13.872	(b)14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	.....	20.000	.....
April	50.000	.....	20.000	.....
May	50.000	.....	20.000	.....
June	50.000	.....	20.000	.....
July	50.000	.....	20.000	.....
August	53.704	.....	20.000	.....
September	64.200	.....	20.000	.....
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound; (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	.....	87.278	.....	35.000	.....
April	11.500	.....	90.800	.....	35.000	.....
May	11.712	.....	86.769	.....	35.000	.....
June	12.000	.....	86.615	.....	35.000	.....
July	12.000	.....	86.960	.....	35.000	.....
August	12.000	.....	84.407	.....	35.333	.....
September	12.910	.....	140.000	.....	40.080	.....
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for February. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	.....	20.50	.....	21.00	.....
April	21.50	.....	20.50	.....	21.00	.....
May	21.50	.....	20.50	.....	21.00	.....
June	21.50	.....	20.50	.....	21.00	.....
July	21.50	.....	20.50	.....	21.00	.....
August	21.50	.....	20.50	.....	21.00	.....
September	22.50	.....	21.50	.....	22.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

What Metal Statistics Show

PRODUCERS became apprehensive as they saw metal prices slip downward in February, but later in that month they witnessed heavy buying of copper, lead, and zinc, and prices regained some of their losses. This relieved the situation, and early in March producers felt the statistical position of the three metals would justify steady production well into the second quarter, providing consumption continues to hold at a satisfactory rate. New orders to consumers, however, are reported slow in coming in, and with the uncertainty over war or peace developments this spring in Europe, a strong feeling of caution prevails.

The domestic copper statistics of Copper Institute for December and January, in tons, follow:

Production:	Dec.	Jan.
Crude	(a)	89,861
Refined	(a)	84,421
Deliveries refined:		
Domestic	(a)	91,428
Export	(a)	17,037
Stock at end	159,485	135,441

(a) Not available.

▶ TIN—World tin production during 1939 totaled 182,600 long tons, according to an estimate by the International Tin Research and Development Council. This compares with 149,000 tons in 1938 and 208,000 tons in 1937.

For the four quarters of 1939 the export quotas were 45, 40, 120, and 100 per cent of the standard tonnages, respectively, averaging 76¼ per cent for the whole year. In 1938 the rate of operations averaged 53¾ per cent and in 1937 the rate was 107½ per cent.

Production of the signatory countries in the control plan and the nonsignatory countries for the last three years, in tons, was approximately as follows:

	1937	1938	1939
Signatories	179,700	119,400	153,490
Non-signatories	28,300	29,600	29,200
Totals	208,000	149,000	182,600

Apparent consumption of tin for the world during 1939 was 165,700 tons, compared with 151,500 tons in 1938 and 199,100 tons in 1937.

▶ LEAD—Stocks of refined lead in the hands of producers at the end of January totaled 68,539 tons, an increase of 9,762 tons for the month. Production increased from 45,615 tons in December to 49,683 tons in January.

The refined lead statistics for the months of December and January, in tons, according to the American Bureau of Metal Statistics, are summarized as follows:

	Dec.	Jan.
Stock at beginning	58,061	58,777
Production:		
Domestic ore	42,547	47,149
Secondary and foreign	3,068	2,534
Totals	45,615	49,683
Domestic shipments	44,881	39,875
Stock at end	58,777	68,539

▶ ALUMINUM—Production of virgin aluminum in the United States during 1939 was the largest on record, amounting to 327,090,000 lb., according to the United States Bureau of Mines. Production was 14 per cent greater than in 1938 and exceeded the previous peak reached in 1937 by 12 per cent.

The increase in production was caused by heavy demands for the metal for national defense preparations and the war abroad. In 1939 the aircraft industry consumed twice the amount of aluminum that it did in 1937, the previous record year. Withdrawals from producers' stocks totaled 62,886,000 lb. in 1939, compared with an addition to stocks of 112,959,000 lb. in 1938, the Bureau's report shows.

Virgin aluminum output of the United States during the last five years was as follows:

	Production Pounds	Value
1935	119,295,000	$22,070,000
1936	224,929,000	41,612,000
1937	292,681,000	55,609,000
1938	286,882,000	56,659,000
1939	327,090,000	64,600,000

▶ ZINC—The December, January, and February statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Dec.	Jan.	Feb.
Stock at beginning	61,522	65,995	65,602
Production	57,941	57,158	54,532
Production daily rate	1,869	1,844	1,880
Shipments	53,468	57,551	53,048
Unfilled orders	53,751	36,808	47,496
Stock at end	65,995	65,602	67,086

Figures covering operations of the Prime Western division, for December, January and February, follow:

	Dec.	Jan.	Feb.
Stock at beginning	30,941	30,052	26,812
Production	25,497	24,689	23,687
Shipments	26,386	27,929	22,915
Stock at end	30,052	26,812	28,484

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922-3-4)

1929	110.33	1934	69.56
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
1939	77.71		

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	....
April	71.19	74.79	....
May	69.15	73.61	....
June	67.55	73.17	....
July	72.95	71.95	....
August	73.94	73.88	....
September	74.70	83.07	....
October	77.61	84.25	....
November	78.36	83.80	....
December	77.13	82.89	....

Zinc Imports and Exports

The following table shows imports and exports of zinc, in short tons, compiled by the American Bureau of Metal Statistics from records of the Bureau of Foreign and Domestic Commerce:

IMPORTS

	Dec. 1938	Dec. 1939	Jan.-Dec. 1938	Jan.-Dec. 1939
Zinc in ore:				
Mexico	...	6,925	7,254	23,220
Argentina	...	393	...	1,544
Peru	...	5,375	11,330	9,722
Canada	...	1,573	...	1,613
Totals	...	14,266	18,584	36,099
Zinc as slabs, blocks, etc.:				
Canada	270	1,003	2,345	6,908
Mexico	200	705	3,746	16,554
Belgium	...	...	286	4,677
France	...	...	...	896
Norway	...	...	...	1,456
Poland	101	...	1,008	808
Other countries	...	79	101	124
Totals	571	1,787	7,486	31,423

EXPORTS

Zinc as slabs, plates, etc.	393	2,666	5,736	4,515
Zinc as sheet and strip		868		6,419
Zinc dust	149	206	2,253	2,834
Zinc in manufactures (a)	1,000	2,000	9,900	14,900
Totals	1,542	5,740	17,889	28,668

(a) Probable amount of zinc used in galvanized products exported, including galvanized iron and steel sheets, wire, barbed wire, and pipe, estimated by the A.B.M.S. and based on actual exports of such products.

CALIFORNIA

Harvard Gold Mine Under Development

Property in Tuolumne County is under option to Alaska Juneau Gold Mining Company—Marshall Mining & Milling Company reopens the Big Sandy mine

▶ Comprehensive development continues at the Harvard gold mine, at Jamestown, Tuolumne County, under option to the Alaska Juneau Gold Mining Company, P. R. Bradley, president. Sinking of an air shaft and enlargement of drifts are in progress, with about 20 men employed under J. Hamner, superintendent. The work is directed by P. R. Bradley, Jr., who is also in charge of the Pine Tree and Josephine unit of Pacific Mining Company at Bear Valley, Mariposa County.

▶ The Marshall Mining & Milling Company has reopened the Big Sandy property near Kelsey, El Dorado County, and expects to start development work on the adjoining Grey Eagle claim some time this summer. Both holdings were worked by James W. Marshall about 80 years ago. The 325-ft. Big Sandy shaft has been rehabilitated to the 225-ft. level, and the 25-ton mill is handling development and custom ore. The company is headed by C. L. Hogan, Menlo Park, with E. M. Cooper in charge of operations.

▶ The Eagle-Shawmut mine, near Chinese Camp, Tuolumne County, operated by the Miller and Clemson interests, of Los Angeles, is producing again after a brief shutdown pending installation of a new treatment plant. About 200 tons of ore a day are treated by flotation and mine development is proceeding according to plans. D. C. Peacock, superintendent, is in charge of operations.

▶ Operations have been resumed at the Morning Glory mine, near Alleghany, Sierra County, after completion of a leasing arrangement between a group of Alleghany mining men and the Morning Glory Mining Company. Work completed recently includes unwatering the 475-ft. shaft and examination of underground workings. The property adjoins the Original Sixteen-to-One mine, and is equipped with a five-stamp mill and hoisting and air-generating machinery. Operations are being directed by E. H. Breuning.

▶ Lode Development Company has closed down the Rosencranz and Taylor operations in Garden Valley, El Dorado County, and is engaged in developing the Lee Pierce drift gravel mine 10 miles northeast of Forest Hill, Placer County. Work is centered in rehabilitating the bedrock tunnel leading to a raise in the gravel channel proper. The small crew at work under W. Wilson, foreman, will be augmented in the spring to push planned development. Charles H. Brown is superintendent.

▶ With abundant water available for hydraulic giants and sluices, hydraulic mining operations have been resumed by the Swanson Mining Corporation at the placer holdings formerly operated by the Salyer Consolidated Mining Company near Weaverville, Trinity County. About 25 men are employed.

▶ Yreka interests headed by James Davis, attorney, have completed erection of a 50-ton mill at the Ukonom mine, on the Klamath River north of Yreka, Siskiyou County. The property has been under development for some time.

▶ Mining operations are reported to have been started by Bradley Turner Mines, Inc., on large placer holdings tested recently by the company near Camptonville, Nevada County. Machinery available includes a gas-electric shovel and gravel-washing equipment. Henry Clay is manager.

▶ According to word received from Placerville, Alhambra-Shumway Mines, Inc., owners and operators of the noted Alhambra mine, near Kelsey, El Dorado County, have acquired the Veerkamp and Daisy Rolfe properties, in Garden Valley, El Dorado County, with preliminary work already under way at the Veerkamp. This property was worked a few years ago by Gold Company, Ltd., and later by the Wiley & Helm interests. Ray Hendricksen directs operations for the Alhambra-Shumway Company.

▶ Dredging operations are proceeding satisfactorily at the Maben holdings south of Grass Valley, Nevada County, where a dragline unit was installed recently by L. W. Oakley and associates to handle both gravel and tailings washed down Wolf Creek from Grass Valley quartz mines.

▶ Installation of a 50-ton mill is nearing completion at the Eclipse mine, near Auburn, Placer County. The property is operated by the Ophir Nevada Mining & Milling Company, with William Ragesdale, superintendent, in charge.

ARIZONA

Bi-Metal Mine Taken Over by New Company

Plans for mill being studied at the property operated by Geronimo Gold Mining Company—Phelps Dodge Corporation adds to fleet of heavy-duty trucks

▶ The Bi-Metal mine, about three miles southwest of Kingman, has recently been taken over by the Geronimo Gold Mine Company, a recent Arizona corporation. Leslie Saunders is manager. It is reported that plans are being studied for the installation of a new mill. During the past several years ore has been shipped to the Oatman mill for treatment.

▶ The Morenci Branch of Phelps Dodge Corporation has put into operation the fifth big power shovel. A fleet of ten-wheel Ford trucks to be used where the present 42-ton type are not usable was recently purchased. A third unit of 70 houses is being erected by P. W. Womack, Phoenix contractor. About twenty adobe residences are also being erected. Ernest Wittenau, of Morenci, is general superintendent.

▶ The Vivian mine, three miles west of Oatman, in Mohave County, is operating at capacity on ores from the Western mine, which the company operates, and on custom ores from various properties in the Oatman district.

▶ The Silver King mine, 12 miles southeast of Kingman, is being operated by the Symon Brothers Screen Company, of Hollywood. A compressor has been installed. The work of cleaning out the old tunnel is under way and will be continued into the old workings. Walter Meyer is superintendent. The company recently took over the Gold Medal group owned by J. H. Cochran, and operations will start as soon as a road is constructed to the property. The company has also optioned the Columbus group of claims belonging to Frank Walker.

▶ J. L. and Jack McIvor, of Oatman, are reported to have sold their Telluride property, in the Oatman district, to T. H. Hodges, also of Oatman. Hodges has been operating the property under lease for some time and has been shipping ore to the Producer's mill, near Chloride.

▶ J. M. Lafferty and J. E. Wenger, former placer operators in Alaska, have taken over the Peach and Schreck placers, in the Lynx Creek district near Prescott, and have installed a quarter-yard shovel and bowl plant for testing purposes.

▶ The Double Eagle Mining Company is installing a 25-ton amalgamation and cyanide plant on its Golden Eagle claim. D. A. Harwood, of Santa Ana, Calif., is managing director of the company.

▶ Dr. Felix Ochs, mining engineer with the Continental Mining Corporation, of 80 Broad St., New York City, and Paul Guterman, of the same company, were recent visitors in Kingman and Mohave County for several days. While here Dr. Ochs made an examination of the Ed Williams tungsten properties, in the Francis Creek district 45 miles southeast of Kingman.

▶ The California Spray Chemical Company, which recently took over the McCracken mine, 40 miles south of Kingman, under the name of Orthodox, Inc., is installing a 175-ton testing plant for tailings and ore treatment. O. F. Marvin is in charge of operations.

▶ The Daily mine, in Pina County, for many years under development by J. W. Daily, P. O. Box 2086, Tuscon, was recently taken over under agreement with Mr. Daily by Robert Burney, B. Anderson, and Newton Wells, officers of the Control, Mines Inc. Operations are on a two-shift basis, mining and concentrating about 100 tons of copper, silver, and gold ore per day. Concentrates are being shipped to the Hayden smelter.

▶ High-grade silver ore is reported to have been found in the Rubiana claim a short distance west of Ruby. A recent shipment showed high in silver and lead, with some copper, zinc, and gold. George R. Green is in charge of the work.

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View of open pit of the Nevada Consolidated Copper Corporation near Kimberly, Nev. In the upper right is seen the headframe of the Emma shaft of the Consolidated Coppermines Corporation, where underground mining operations are practiced

NEVADA

Two Custom Smelters Under Construction

Small capacity plants will serve mining districts in Lander County—Quicksilver mines active in Bottle Creek area

▶ Two custom smelters, described as "pilot" plants and each of 60 tons' daily capacity, are to be constructed by the National Mining, Smelting & Refining Company in two districts in Lander County, one at Galena, 10 miles south of Battle Mountain, and one in the McCoy district, 22 miles farther south. Grading and some foundation work for the latter has been completed. The project is headed by Leo Manson, formerly of Milwaukee, and Frank Skaggs, of Reno, with an office at Battle Mountain.

▶ The Bottle Creek district, in northern Humboldt County, is currently Nevada's most active center of quicksilver mining, with four retort furnaces in production and preparations for early installation of two or more rotary furnaces. J. O. Greenan, of Reno, has provided a new compressor and other equipment for his Blue Can mine and has acquired and equipped an adjacent group. James and Arnold Scossa, operating a retort furnace, were reported to have sold their cinnabar property to Hollywood men, and four other properties are producing mercury.

▶ A newly installed 30-ton rotary furnace on property of the White Horse Quicksilver Mining Company in the northeastern corner of Churchill County is reported to be producing two flasks of mercury per day. A crew of twelve men is employed and camp facilities have been provided. The cinnabar deposit was discovered a few months ago by Clyde Garrett, widely renowned prospector and ore-finder, who sold the claims to Henry W. Gould of San Francisco. Bruce Gould is in charge of operations.

▶ Operation of a 35-ton amalgamating and concentrating mill at the widely-publicized Jumbo mine, in the Awakening district, Humboldt County, has been discontinued for the winter months because of snow-blocked roads, over which the ore is trucked 6 miles from the mine. Development work continues with a small force under direction of George B. Austin, who in 1938 gave an option on the mine for $10,000,000 to wealthy Texas oil men. This option was relinquished late last year.

▶ President Atterbury of Consolidated Coppermines Corporation recently advised stockholders regarding negotiations with Kennecott Copper Corporation as follows; "Through amendment of the Settlement and Operating Contracts with Kennecott Copper Corporation arrangements have been completed for handling a larger tonnage of Coppermines ore at a lower cost per ton. From Oct. 1, 1940, there is to be a reduction of 8 c. a ton in the basic charges for freight and milling. The tonnage limit per operating day has been increased from 6,000 tons to 8,000 tons effective forthwith and to 9,000 tons beginning Aug. 1, 1940, with provisions for further increases under certain circumstances. It should be noted that it is not correct to infer a fully corresponding increase in the output of copper. There is a necessary time lag in the development of the mine to the higher production level. Market conditions might not justify capacity operations. Furthermore, the copper content per ton of ore in recent years has been running somewhat above the average grade of the mine as a whole. There are also favorable modifications in several other respects, notably in the provisions governing the resumption of operations after a shutdown. Coppermines retains its right to terminate the Operating Contract as a whole or with the exception of provisions relating to smelting, such right of termination to become effective on Jan. 1, 1948, or sooner if 12,500,000 tons of concentrating ores shall have been delivered subsequent to Jan. 1, 1940. The period covered by the agreement has been extended from Dec. 31, 1967, to Dec. 31, 1975. The completion of these arrangements makes unnecessary at this time the financing which had been contemplated for the construction of our own concentrator and is evidence of the spirit of goodwill prevailing between Kennecott Copper Corporation and ourselves. Your Company's auditors are now preparing their report for 1939. Copper production for the year was approximately 47,400,000 lb., a new high record."

▶ Shipments of smelting ore from the Pioche district, in Lincoln County, have been increased substantially in volume, as much as 2,400 tons having been shipped to Utah plants in a week. Foremost producer of the area is the Combined Metals Reduction Company, now producing from both its No. 1 and Caselton mines, connected last year by a mile-long crosscut on the 1,200-ft. level of the main Caselton shaft. Bristol Silver Mines Company, for which J. H. Buehler is manager, also is shipping a considerable volume to the Combined Metals plant at Bauer, Utah.

▶ Preparations for increasing truck shipments of gold ore from properties of the Comstock Gold Point Mines Company and the Currant Creek Mining Company in the Currant Creek district were reported by John N. Richardson, manager for both companies. A contractor, operating a 225-hp. diesel-powered truck and trailer, is delivering two 30-ton loads of ore per day to the McGill smelter of the Nevada Consolidated Copper Corporation, 60 miles from the mines but nearly all over an improved highway. Both companies plan to grant leases on sections of their large groups of claims.

▶ Equipment added recently to the plant of the Tungsten Metals Corporation in the Shoshone district, eastern White Pine County, has increased capacity to 130 tons per day. It is the second largest producer of tungsten in Nevada. Paul J. Sirkegian, assistant geologist for the Consolidated Coppermines Corporation, is president and manager, with company office at Ely.

METAL AND NON-METALLIC MINING CATALOGS PUBLISHED THIS MONTH

FORMERLY KNOWN as "Metal Quarry Catalogs," the 1940 edition of this annual composite catalog has been renamed "Metal & Non-Metallic Mining Catalogs," to indicate its broader scope. It is designed as a time-saving convenience for officials and engineers in the mineral industries who are responsible for specifying and buying machinery, equipment, and supplies for mining, milling, smelting, and refining operations. It will be sent gratis to individuals who qualify in these capacities. Inquiries should be addressed to "Metal & Non-Metallic Mining Catalogs, 330 West 42d St., New York, N. Y."

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NEWS FROM Washington

By Special Correspondent

FACT FINDING is a job of the administrative agencies of the Government. The Supreme Court says that it is neither the duty nor the privilege of the Federal courts to determine the correctness of the fact finding or to substitute judicial judgment for administrative judgment.

There was no dissenting voice on the Supreme bench when this finding regarding a decision of National Labor Relations Board was handed down on the mid-February decision day. The Court ruled that the Board was itself the agency designated by Congress to pass on the evidence, and that it had the final right to draw conclusions from conflicting evidence before it. The Court even went so far as to say, "Whether this court would reach the same conclusion as the Board from the conflicting evidence is immaterial and the Court's disagreement with the Board could not warrant the disregard of the statutory division of authority set up by Congress."

Administrative Court

THE SUPREME COURT ruling seems merely a reiteration of the traditional opinion that Congress has the right to make executive and administrative agencies the agents of fact finding. But reiteration in such an unequivocal form newly spotlights the problem of fixing safeguards around the administration of such law by the numerous regulatory agencies of the Government. The fact that the Federal Government now has a large number of new "alphabetic" boards and commissions is impressing itself on the collective mind of Congress. Something may be done about it.

The Walter bill is the legislative correction most frequently pressed, and the one that undoubtedly will be the starting point for establishment by Congress of some agency to safeguard procedure in administrative board and commission finding. This fact, pointed out last month in this column of *E.&M.J.*, does not justify the forecast that Congress is going to tear to pieces or restrict radically all of the independent agencies of quasi-judicial nature. Quite the contrary is true.

In reviewing this situation it is important to remember that the Interstate Commerce Commission has for several decades been authorized to make findings of fact which are taken by the courts as final, unless it can be established that the procedure in reaching the conclusions was not sound or that the disposition of the Commission was capricious or unreasonable. The fact that such an agency as I.C.C. can successfully proceed because it is judicially minded persuades Congress that in labor relations, wage-hour findings, and other recent agencies the fault may have been principally, if not wholly, with the personnel rather than with the principle. Congress is likely to proceed on that philosophy, at least for the time being.

But Congress is not pleased that any board, whatever its personnel, can set up procedures that are unreasonable or permit administrative actions that are highly partisan and prejudicial to the good of any party interested. It is that feature of labor legislation which Congress wants to correct.

The Walter bill comes nearest to doing this. It, therefore, will be the basis on which Congress will progress toward the establishment of some judicial agency of review which, for convenience, is being called an administrative court. It is not at all sure that there will be time to complete this legislation before Congress interrupts its affairs to go to the nominating conventions in June. But the various boards and commissions in Washington are already cleaning house. And the mere threat of legislation is going to accomplish much, if not most, of the needed reform.

Export Licenses

A QUEER MIXTURE of realism and emotionalism is working potently toward legislation to require license on exports of minerals and metals. Its objective is to provide legal support for the moral embargo against Japan and Russia. The nominal objective is a control of scrap-iron exports. The result is likely to be much more than that, perhaps extending to numerous metals and minerals.

Sentimental interest backing this movement for export control has been greatly augmented by recent writings which describe the horrors of indiscriminate bombings of Chinese populations by shrapnel "furnished by the United States." These are not unimportant in formulating a Congressional program. The fact that there has been tremendous exaggeration of the importance of American scrap-iron exports to Japan does not destroy the potency of this emotional appeal.

And, strangely, the commercial desire to retain iron and steel scrap in the United States happens to support the emotional appeal. The metallurgical industries would be very glad to retain this supply of valuable raw material for steel making for United States use. They willingly see export of only those types of low-grade scrap for which Japan can pay a price above the value for domestic use. Apparently, only the scrap dealers dislike the thought of Federal control. And their commercial interest is so obvious as to make their appeals rather impotent in Washington.

Mining and metallurgy generally must understand that restriction of ferrous scrap exports by a license system is almost certain to be extended to the control of numerous other strategic materials. The appeal described in *E.&M.J.* last month with respect to rubber and tin re-export is but one symptom that export of other materials of limited supply is bound to be exercised by Uncle Sam before long if the world continues its military activities both in Europe and the Orient.

Mines Bureau Changes

RETIREMENT of James W. Furness from the post of chief of the Economics Branch of the Bureau of Mines involves much more than mere change in an administrative official. He has occupied several very important positions, notably on the committees which have served as advisers to the Army and Navy Munitions Board with respect to strategic minerals and metals. Perhaps most important of all these committees is the interdepartmental committee which drafted the material on which Senator Thomas formulated a bill that became the mineral stockpile law. Appointments must be made to fill these various vacancies as well as the post of chief of the Economics Branch.

Mr. Furness during January requested retirement for physical disability. He had been considering such a move for a year or more. The date of his retirement remains uncertain because the Civil Service Commission had not taken final action in the case. The Bureau and the Department executives had, however, approved his request, and it is anticipated that the termination of his official service may come about the first of April or May.

There have been, naturally, rumors that this retirement of Mr. Furness had some connection with the requested resignation of Dr. Finch as director of the Bureau. *Engineering and Mining Journal* has been definitely assured that there is no connection whatsoever. Mr. Furness' request was based solely on the advice of his personal physicians and the official medical officers concerned. It is believed essential for his health that he be relieved at an early date of the strain of urgent administrative and technical responsibilities.

Mr. Furness had not made any announcements late in February regarding his plans for the future. It is anticipated, however, that he will be able to carry on some restricted type of professional activity in his favorite field of mineral economics.

Stop Silver Buying?

THE SILVER BUYING QUESTION has again become the rugby ball available for political booting all over the Washington legislative field. And polite rules of soccer are not going to be observed. Hobnail boots of partisan sort are likely to be planted square in the face of personal reputations, and deliberately.

This issue, of extreme importance to the mining industry, has achieved almost equal importance within the Democratic party. There is no clean-cut separation of groups. But there are at least two Democratic factions that are using this movement as one means of attempting control of the July nominating convention. The politics of the mining states is particularly involved.

In the West.....it's WEMCO

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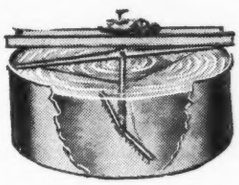

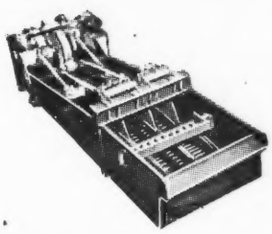

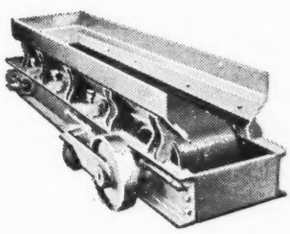

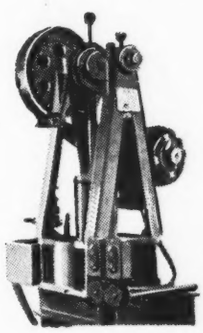

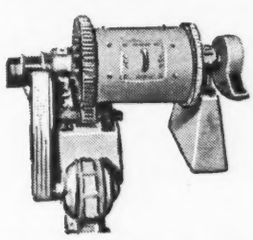

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Fortunately for the silver miner of the United States, there seems to be no disposition to cut off the bonus for newly mined domestic silver. But the anti-Hull faction of Congress certainly would love to take away from the Treasury and State Departments their present leverage in international dealings which is now afforded by the law which makes United States purchase of foreign silver almost compulsory. The fact that it is "almost," and not absolutely, is the point at which the leverage is exerted. Take Mexico, for example: The strongest influence which the State Department can exert on that nation is the threat to cut off all silver purchases, or to promise renewal on a large scale.

The scandal aspect of this whole matter comes in from the alleged irregularities in speculation in silver by persons who are charged with having used their official knowledge as a basis of private speculative profit. How far that factor may be utilized in determining the votes of members of Congress on controversial issues where the vote would otherwise be close, no one can say.

The nominal area of legislative controversy ties up with the Townsend bill which was recommended for enactment by a subcommittee of the Senate Banking and Currency Committee. It would repeal the silver purchase act as it relates to further foreign buying. The Administration does not like this bill, but it may have to take some modified form of it before this phase of political maneuvering can again be put under control. The proposal has considerable official backing, especially among fiscal groups, including unanimous support by the Federal Reserve Bank groups which dislike the Treasury drain which futile silver buying imposes.

Bonneville Iron Plan

THE BONNEVILLE PROJECT announced late in February the signing of contract for sale of electric power to Sierra Iron Company, of Nevada. This firm is to use a process which "involves electric smelting of ore to be obtained from the iron deposits in the vicinity of Scappoose, Oregon. Some magnetite ore will be shipped from Shasta County, in California. Part of the plant production will be consumed in the local manufacture of cast-iron soil pipe. The electric smelting process will use coal from the Chehalis, Washington, coal fields, and Pacific Northwest limestone." This proposal appears quite a different thing than has been talked of in recent news reports which have generally forecast an iron blast furnace using wood coke as a fuel. (See E.&M.J., February issue, page 114.)

Mining and Relief

TWO NEW EFFORTS are being suggested in Congress for use of mining or mineral prospecting as a means of relief. These two take the form of bills introduced by Senator McCarran, of Nevada. In one case the United States Geological Survey is to use unemployed citizens at Government expense for prospecting areas designated by the Survey. The Government would grubstake these men, and would share 50:50 with them in the net proceeds of any mineral development which came from their efforts.

The second proposed legislation is much like the first but would utilize the Works Progress Administration money for carrying out this plan. Again 50:50 sharing with the unemployed prospector would be the bait. Washington does not expect enactment of such weird legislation. But the mining industry will find it symptomatic of some of the official thinking.

Incidentally, the old idea, constantly renewed, that R.F.C. ought to be authorized more fully to loan money for mine prospecting or small new mine development gets little encouragement. That agency already has plenty of authority to loan on any promising prospect, but finds few interesting applicants who cannot do better for themselves by seeking support in commercial channels.

Manganese Awards

Contracts were awarded on March 5 for 10,000 tons of Grade A and 31,000 tons of Grade B manganese ores. The total cost to the strategics stockpile fund will be $1,188,768. No bids for Grade C ore were submitted. About half of these ores are Philippine, about 20 per cent from Canada, and the balance from South Africa, Brazil, and India, with all deliveries scheduled for Baltimore. Details follow:

Commercial Engineering Co., Washington, D. C., Grade A (Canada) 8,000 tons, 60c/l.t.u. unit of Mn.	$240,000
C. Tennant, Sons & Co., New York, Grade A (Philippines) 2,000 tons, 62.8c/l.t.u.	60,288
L. W. Lambert, Upper Lake County, Calif., Grade B (Philippines) 18,000 tons, 65c/l.t.u.	561,600
Derivatives, Inc., New York City, and Tonerde, Inc., New York City (joint award of two lots) Grade B (South Africa) 2,000 tons, 49c/l.t.u.	47,040
Grade B (South Africa, Brazil, and India) 11,000 tons, 53c/l.t.u.	279,840

This practically completes the commitment of the money available now for manganese. One more small purchase may be made later to replace an item formerly committed but subsequently cancelled.

Question Export Sales

GROUPS INTERESTED in the export trade associations which are organized under the Webb-Pomerene law have been disturbed by recent actions of the Federal Trade Commission. One of the most recent of these was interpreted as being an attack on the whole scheme of establishing single export agencies to encourage foreign trade of the United States. The particular case which has roused difficulty has nothing to do with mining or metals, but the principles involved are directly applicable to these mineral industry subjects.

For a long time the Federal Trade Commission has been worried by the thought that the export associations were monopolies, legalized by Congress for foreign trade, but likely to have monopolistic tendencies in the United States also. The Commission has, therefore, on several occasions warned groups that units which are legal for export business may not legitimately do things which have a secondary effect within the United States amounting to restraint of trade. This is but another case that a legal agency is not defensible when it does things even indirectly illegal.

One of the particular complaints of recent date, spot-lighted by the Pacific Forest Industries case, is the thought that the export association is directly influencing prices or terms of sale of goods either by or between member companies that are supposed to be competitive within the United States. Apparently the Commission is going to insist that any industry unit cease and desist from even export practices which have this secondary domestic effect. Especially if the export group undertakes to use its size or power to influence United States transactions of small member or non-member companies, the F.T.C. policeman is likely to be on the job promptly.

Despite this vigilance with respect to domestic anti-trust responsibility, there is no evidence that F.T.C. is rightly charged with any desire or effort to restrict export business in monopoly form by Webb-Pomerene associations.

News "Fines"

Mine Rope Report—Mining engineers generally are being encouraged to study with care the new Bureau of Mines technical paper on "Inspection and Maintenance of Mine Hoisting Ropes." This report is a résumé of practical field studies as well as the researches of the Bureau of Mines. The safety engineers of that agency are hopeful that this technical contribution will add still more to the safety precautions already observed in the mining industry.

Buy United States Minerals—In a recent address Assistant Secretary of War Louis Johnson states as one of the six major planks in a platform of national defense his policy regarding purchasing of raw materials. This part of the program assumes "acquisition, storage, and maintenance of strategic and critical raw materials ordinarily procured from foreign sources." The emphasis on the purchase from foreign rather than domestic producers of these materials is regarded in Washington as merely another reiteration of known Administration policy.

The buying of strategic materials like manganese, tungsten, chromium, and other minerals and metals is not looked upon by high officials as properly a subject of either subsidy for domestic mining or for new domestic employment. The very definition by military authorities of "strategic" and "critical" materials practically precludes the buying from United States sources, since the materials are defined as those for which domestic supplies are not adequate.

Strategics Appropriation—Purchases of strategic materials by the Treasury Department have obligated practically all the $10,000,000 available for this fiscal year of stockpile building. The President asked that $15,000,000 be granted for next year, but Congress has cut this to $12,500,000. It is proposed that part of this curtailed sum be made immediately available when the bill passes, so that purchasing of metals and ores can be speeded up. It is likely that $5,000,000 of the total can be thus committed even before July 1.

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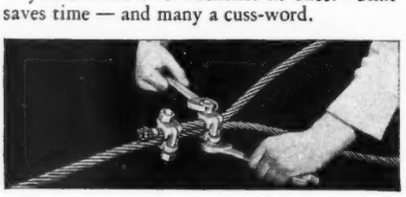

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HERBERT G. MOULTON, on the left, president of the American Institute of Mining and Metallurgical Engineers for 1940, and DONALD B. GILLIES, outgoing president, conclude the reception of officers at the Waldorf Astoria by smilingly shaking hands.

A.I.M.E. Convention Marks 70th Year of The Institute

Papers on mining and milling feature advances in operating technique—Future of America's Industry and our national defense were subjects at all Institute sessions

CONVENING at the 152d meeting during Feb. 12 to 15, members of the American Institute of Mining and Metallurgical Engineers, Inc., found the occasion also marking the 70th year of the Institute's existence. Attendance was well above that of last year and the program of papers dealing with mining and milling technique in the non-ferrous mining industry attracted interest.

As problems and responsibilities of the average mine operator become more complex, and are now becoming affected by another European war, interest appeared to center on papers covering mining methods and the trend of equipment design that is being offered by manufacturers to aid the mining engineer in maintaining profitable operations. Subjects in this field were discussed on Monday morning with Benjamin F. Tillson as chairman. A paper by M. L. Sumners, superintendent of the Gold Hill Dredging Company, Calif., presented the modern trends in gold-dredge design. "Some Outstanding Mine Hoist Equipment" was the subject of a paper read by B. V. E. Nordberg, executive engineer of the Nordberg Manufacturing Company, Milwaukee, Wis. H. H. Logan, president, Logan Engineering Company, presented a paper dealing with mine hoist controllers. Some factual merits of truck haulage were discussed in the paper "Trucks and Truck Operation at the Mahnomen Mine," by Frank A. Kelley, general superintendent, Pickands, Mather & Company.

The All Institute session featured an address by Merlin H. Aylesworth, former president of the National Broadcasting Company, on "The Future of American Industry." Mr. Aylesworth stressed the importance of industries' public relations that must constantly fight the propaganda of crackpot schemes. He said: "The question is, will business seize the opportunity to justify itself at the court of public opinion or will it continue to permit politicians to harass it and ultimately subdue and conquer it? I am confident that business now sees the violent necessity of public enlightenment as to its processes and will not only preserve free enterprise, but the American system. I am an optimist about the future of American industry. For ten long years it has been abused by muddle-headed economists, terrorized by political charlatans, and attacked on all sides with all sorts of weapons by Socialists, Communists, and that wide assortment of fuzzy thinkers."

Discussing his subject, "Industry and Defense," Lieut.-Col. L. A. Codd, executive secretary Army Ordnance Association, pointed out that this country, by reason of its advanced industrial power, is far better equipped to maintain its peace than ever before. He declared, "The first of two most commendable steps of Congress was the approval of educational orders to American industry for production of military armament in time of peace, while the second was the procurement of a stockpile of strategic materials for our armed forces."

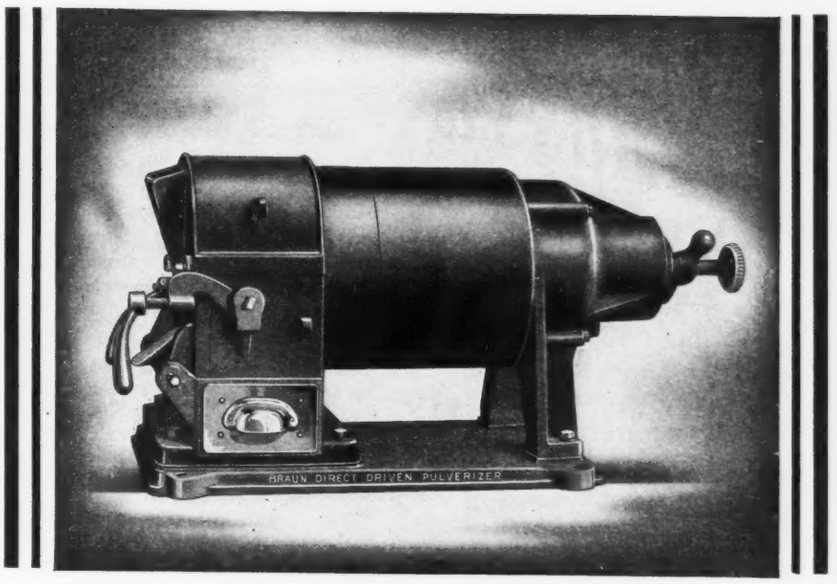
Subjects on mining methods continued on Tuesday, when the following papers were discussed: "Use of Diamond-impregnated Cemented Carbide Core Bits," by W. C. Weslow, engineer Carboloy Company, New York; "Thermit-welded Track for Main Haulage Lines," by C. D. Young, district manager Metal & Thermit Corporation, New York. The paper by Harlan A. Walker, assistant general manager, Homestake Mining Company, entitled "Recent Trend in Drill Steel Gage at Homestake," was presented by

N. Herz, delegate from South Dakota. "Hot-Milling of Rock-drill Bits," a recent technique in detachable-bit repair, was discussed by R. C. Berggren, of the Marcy mill division, of the Mine & Smelter Supply Company. J. W. Dougherty, mine superintendent, and J. M. Douglas, mine captain of the Hollinger Gold Mining Company, had a paper describing the mining practice employed at that Canadian property.

J. Murray Riddell was chairman of the Tuesday morning meeting. In the afternoon, among milling subjects disdussed were "Oxygen-free Flotation With Galena," by S. F. Ravitz, Utah Engineering Experiment Station; "The Sedimentation Balance of Measurement of Size Distribution of Fine Materials," by Fred C. Bond, Allis-Chalmers Manufacturing Company; "Principles of Comminution, I-Size Distribution, and Surface Calculation," by R. Schumann, Jr., of the Massachusetts Institute of Technology; "Automatic Control of Pulp Density," by J. A. Adams, Mine & Smelter Supply Company, and "Launders" presented by Harold A. Linke, of the Utah Copper Company.

Wednesday's session discussed more mining and milling subjects, some of which were: "Modern Placer Prospecting," by W. F. Nothacker, of C. Kirk Hillman Company, Seattle, Wash.; "Development for Low-Grade Manganese Ore of Cuba," by F. S. Norcross, Jr., of the Cuban Mining Company; and "Crushing and Grinding Practice of the Tennessee Copper Company," by J. F. Myers and F. M. Lewis, of the Tennessee Copper Company. The metallurgy and milling practice at the Getchell mine were explained in a paper by Fred Wise and C. W. Wark, general superintendent and mill superintendent, respectively, of the Getchell Mine, Inc., Nevada. An illustrated discussion of the subject of "Strategic Minerals Investigation" was prepared by C. F. Jackson, chief engineer, Mining Division, United States Bureau of Mines.

The annual banquet and reception held at the Waldorf-Astoria on Feb. 14 was also the occasion for presenting medals and honors. The James Douglas Medal was presented to the late Louis Davidson Ricketts "for inspirational leadership and distinguished achievements in the metallurgy of copper." (Mr. Ricketts died March 4 at the age of 80.) E. De Golyer received the Anthony F. Lucas Medal "for initiating applied geophysics, directing the early practical seismic exploration and fostering applied science in finding, developing, and producing oil." The Robert W. Hunt Medal for 1940 went to Axel Hultgren and Gosta Phragmen, of Sweden, for their joint paper contributed to the Institute, entitled "Solidification of Rimming-steel Ingots." Henry Krumb, vice-president of the Institute for the last twelve years, received a certificate of Honorary Membership "in recognition of his attainments as an engineer; of his efforts in behalf of the profession, and his counsel in the administration of the Institute's affairs." The J. E. Johnson, Jr., Award was presented to P. V. Martin for his research on the "Effect of the Solution-loss Reaction on Blast-furnace Efficiency." Herbert G. Moulton was introduced as President of the Institute for 1940.



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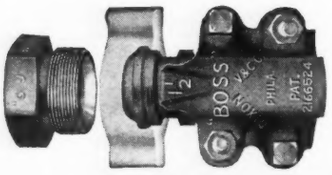

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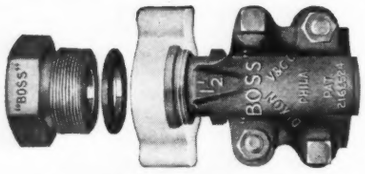

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IDAHO

Development Discloses Good Ore at These Mines

Sunshine Mining, St. Elmo Mining Company, and Coeur d'Alene Mines Corporation report ore strikes—New placer dredge scheduled for summer operations in Salmon River district

▶ Sunshine Mining Company has ore reserves blocked out and ready for mining estimated at 640,000 tons, the largest reserve in the history of the mine and sufficient for two years' production at present capacity, President R. M. Hardy stated in his annual report. An important development was made recently in the discovery of a new vein 145 ft. north of the Sunshine vein. On the 2,500-ft. level where it has been opened for 50 ft. in length values over a width of 5 ft. average 80 oz. silver to the ton. Sinking operations have been resumed in the Jewell shaft from the 3,100-ft. level. The next station will be at the 3,700-ft. level.

▶ St. Elmo Mining Company, Coeur d'Alene district, has opened some high-grade silver-copper ore in its lower tunnel. The discovery was made by the mine foreman in blasting some "bootleg" holes left by former miners in a small crosscut. A raise will be run on the ore to connect with upper workings.

▶ Coeur d'Alene Mines Corporation, Coeur d'Alene silver belt, unexpectedly broke into a new shoot of high-grade silver ore on the 2,400-ft. level the week of Feb. 15. The new ore is about 5 ft. wide, company officials state. Engineers said it was probably a part of the original vein system faulted to the south. The discovery was made in blasting out for timber sets.

▶ Pacific Placers Engineering Company, of Los Angeles has leased about 1,200 acres of ground in the Salmon River district from the Salmon River Placer Company. Plans call for a dry-land dredge plant at the site by August, capable of handling 5,000 cu. yd. daily. The ground is in one of the remotest areas of the state. More than 300 tons of mining equipment were flown into the area from 1936 to 1938 for the Salmon River Company.

▶ Leasers at the Electric Point mine, at Northport, Wash., recently found a 19-ton boulder of crystallized lead embedded in a chimney of ore they were mining. The rock assayed 83½ per cent lead and 16½ per cent carbon dioxide.

▶ The Pearl Mining district, in Gem County, is the scene of new mining activity. The Huron Mines Company, operating the Lincoln mine, has 40 men employed. A 60-ton milling plant was installed last fall. J. L. Fozard is president. The Pearl Mining Company is operating a 40-ton mill and employing 10 men, according to W. S. Kehrer, of Boise.

▶ Birthday Consolidated Mines Company has shipped four cars of gold ore from a new property near Lowman. The cars averaged 1½ oz. gold per ton. The company is said to have opened four gold quartz veins with 2,353 ft. of development work. A 100-ton flotation plant is planned for the near future.

▶ The Idaho Bureau of Mines and Geology and the United States Bureau of Mines, in cooperation with the University of Idaho, offers several fellowships in the School of Mines. These fellowships are open to college graduates who have had good training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The net income of each fellowship over and above University fees and deposits is $50 a month for ten months beginning Sept. 1, 1940. Application, with certified copy of college record, statement of professional experience and names and addresses of three references, together with recent photograph, will be received up to April 1, 1940.

▶ Fred H. Merritt, of Weiser, has secured a lease on the famous old Belshazzar gold mine, near Quartzburg.

▶ Silver Summit Mining Company, Coeur d'Alene silver belt, has been granted permission by the SEC for the listing for sale of 183,679 shares of stock to be offered to present shareholders at 50c. per share. The issue is expected to raise $91,839.50, which will be used to explore the vein system now being opened by deep shaft work from the 1,200-ft. level. Harry P. Pearson, Wallace, is president-manager.

MONTANA

Anaconda Copper Acquires Butte & Superior Claims

Well known zinc mine included in deal—Wages of copper miners decline 25 cents per day—Statistical position of copper not expected to require any immediate curtailment in operations—Outlook for summer, however, is uncertain.

▶ On Feb. 23 the Anaconda Copper Mining Company consummated a deal whereby it acquired all the Butte Superior properties covering about seventy mining claims, including the Black Rock mine, a famous zinc producer. This mine, however, has been idle for the past ten years. Past production has averaged about 15 per cent zinc and 5 oz. of silver. The deed was signed by D. C. Jackling, president of the Butte & Superior company, and George Moser.

▶ Though metal prices have dropped slightly in current weeks, from the 12½c level to 11½c. the statistical position of refined metal stocks is believed to be such that production curtailments at Butte may be avoided at present. Though domestic copper producers throughout the west have reflected increasing apprehension in recent weeks, the Anaconda Copper Mining Company has not announced any change from production rates attained late in 1939. The Butte wage scale was reduced 25c. per day, effective March 4, following one month's average copper price under 11½c.

▶ Reporting the 1939 production at the Butte Highland Mining Company, W. S. Norman, president, stated that gross receipts for the year were $354,124, derived in milling 19,504 tons, indicating an average return of $18.16. After paying dividends of $43,033, the cash in banks is $89,887, which is about 50 per cent greater than at the corresponding period a year ago. W. L. Bell, manager, reports that drifting is being continued is siliceous milling ore on the 875 level, and shaft sinking is in progress below that level. Also, a raise is being continued to surface.

UTAH

Conveyor System Moves Waste at Silver King Mine

Automatic feed controls volume of rock dropped on belt—D. C. Jackling presents employees of Utah Copper with medals—Elton Tunnel at halfway mark

▶ Net proceeds of the Silver King Coalition Mines Company, Park City's oldest and largest producer, amounted to $485,001.74 in 1939, according to a report filed with the State Tax Commission. The Park Utah Consolidated Mines Company and the Park City Utah Mines Company reports showed the first property to have net proceeds of $5,486 and the latter to have no net proceeds, but gross proceeds of $85,423. The New Park Mines Company reported an operating loss of $30,478. Sinking of the new Thaynes Canyon shaft of the Silver King Coalition Mines Company had reached on Feb. 16 a depth of 1,772 ft. without a serious accident. Eight skip pockets have been dug at various levels. The company in February put into operation the first conveyor belt system for dumping waste ever installed in the State. Three-ton skips are dumped into a 125-ton waste bin. An automatic feed controls the amount of waste deposited on the 18-in. rubber conveyor belt.

▶ Col. D. C. Jackling, president of the Utah Copper Company, presented gold medals, gold lapel pins, and service certificates to 32 employees at a dinner held Feb. 3 at the Hotel Utah, attended by 400 officials and workers. The employees honored had completed twenty years' service with the company during 1939. L. Buchman, general superintendent, was toastmaster and Jack E. Whiteley responded for the 1939 "class."

▶ The Elton Tunnel of the National Tunnel and Mines Company reached the 12,000-ft. mark on Feb. 16. Average progress is from 25 to 30 ft. a day. Water flow amounts to 5,000 g.p.m. Started in 1937, the tunnel has now reached the halfway mark.

▶ The Little May Mining Company is following a seam of ore in its Milford Lilly mine, Beaver County. Tunneling and drifting are being carried on in the company's Tintic property, reports Manager John Matson.

▶ Alta United Mines Company, announces George H. Watson, president,

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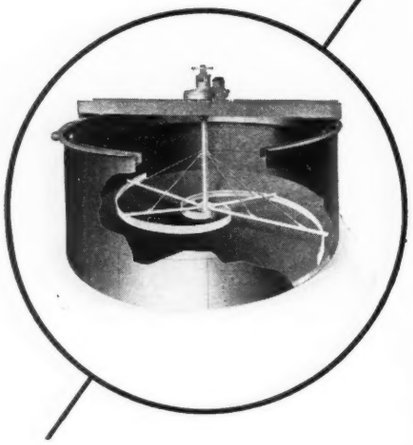

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▶UTAH

plans to extend its Quincy tunnel to prospect the Wellington ore zone and extend the Dwyer tunnel to the Paddock and other fissures.

▶ The Prosper Mining Company, controlled by Edward Schoo, Raymond Spykerman, and James Morrissey, has shipped three carloads of ore from its recently acquired Old Hickory mine, 8 miles west of Milford, Beaver County. The first shipment carried 0.025 oz. gold, 3.5 oz. silver to the ton, and 8.27 per cent copper.

▶ High-grade ore has been opened up in the Lynch-Glenny incline operated under lease from the Ophir Queen Mining Company in the Dry Canyon district near Ophir.

▶ The Kennecott Copper Corporation, operating the Utah Copper mine at Bingham, filed on Feb. 12 in the Federal District Court a suit seeking to condemn land in the West Mountain mining district, principally owned by the Freeman Gulch Mining Company. The Kennecott Corporation contends that it needs the ground for dumping waste rock.

COLORADO

Cashin Mine Expected To Be Reopened

Simpson Mining Company planning operation of old copper property—United Gold Mining Company reports finding ore in virgin territory

▶ The Cashin mine and mill (idle for many years), which is at the southern base of the La Sal Mountains, Rico, Colo., expects to resume operations shortly, according to E. P. Simpson, president of the Simpson Mining Company, Salt Lake City, Utah. The mill is of 50-tons daily capacity. This property was made famous years ago, due to its deposits of almost pure copper. The ore also contains gold and silver.

▶ The United Gold Mines Company recently opened up a 5-ft. vein of fairly good ore in virgin territory and a cut out is being made for a stope 75 ft. in length; after which an attempt will be made to determine if the richer ore will be above or below the present drift. Following the recent fire at the Portland, the new ore house at the No. 1 shaft will be built of steel. A new flat cable, 3,700 ft. long has been purchased for the Portland shaft in preparation for deeper mining on completion of the new Cripple Creek drainage tunnel.

▶ The Southern Colorado Power Company recently completed construction of a new power line down the north slope of Bull Hill to the School Section and Cameron properties. New and larger transformers have been set up at the Cameron mine and mill for more adequate service.

▶ The new 75-ton concentrating mill in California Gulch, Leadville, completed in 1939, was built for an outlet for the mine output and dumps of the Venir Company's property in Breece Hill, operated by John Cortellini. The low-grade ore must be milled, and this new mill has proved a success to date. L. S. Harner is general superintendent.

▶ The Mesa Vanadium Company, organized recently by Grand Junction men, has installed a 10-ton mill on the Dolores River at the mouth of Disappointment Creek in San Miguel County, about 16 miles from Cedar. Frank N. Nisley, Jr., is superintendent.

Modern Pioneer Awards

AMONG 572 scientists, engineers, and inventors selected by the National Association of Manufacturers to receive awards as Modern Pioneers on the American Front of Industry, were a number of industrial and professional representatives of the mining and metallurgical industries. Allis Chalmers Manufacturing Company announced awards for Walter Geist, W. M. White, and R. C. Newhouse. Timken Roller Bearing Company was honored by the selection of Tracy V. Buckwalter; Oliver United Filters, by E. L. Oliver and E. J. Sweetland; the Merrill Company, by C. W. Merrill; Singmaster and Breyer, by Frank G. Breyer; Union Carbide & Carbon Corporation, by Frederick M. Becket; United Chromium, Inc., by Colin G. Fink; American Cyanamid Company, by Walter S. Landis; Worthington Pump & Machinery Company, by Max Spillman, John F. Grace, and Thomas C. McBride; Western Precipitation Company, by Walter A. Schmidt, Evald Anderson, and Harry V. Welch. Among those who received awards as National Modern Pioneers were J. V. N. Dorr and F. G. Cottrell.

TRI-STATE

Easing of Cold Weather Improves Operations

Production in district gradually increasing but many mines remain closed—Eunamar Mining Company obtains encouraging results from drilling on Chenoweth land

▶ With the moderation in the cold weather, production in the Tri-State district is gradually creeping back towards 7,000 tons per week for zinc concentrates. Forty mills were in operation the latter part of February, including 11 tailings re-treatment mills and one mill on mixed feed of mine ore and tailings. It is possible that several more mills will be brought back into production in the next few weeks, but several operators have indicated that they cannot produce from their low-grade properties at present prices. New development in the district continues to lag and presents the most unsatisfactory feature for the future.

▶ The Eunamar Mining Company has reported a good strike in drilling on the Chenoweth land about 4½ miles north of Joplin. Good zinc ore was encountered from 155 to 175 ft. in a drill hole put down to check earlier drilling by the Mattheisen & Hegeler Zinc Company. L. E. Gager, president-treasurer of the company, reports that if further drilling

proves up a commercial orebody, the company's mill in the southeast part of Joplin will be removed to the Chenoweth land.

▶ The Dines Mining Company started its mill north of Picher, Okla., in Kansas, on Feb. 20. The Southern mine of the company has been contracted by W. A. Childress and associates, of Joplin, Mo. Approximately 75 men will be employed at the mine and mill. H. G. Weidman, superintendent for the company, reports that development work is being done on the Evans-Wallower No. 2 lease just east of the mill.

▶ The Eagle-Picher Mining & Smelting Company closed down the mines on the See Sah, Blue Goose, Humbahwatah No. 2, and John Beaver No. 2 properties late in January. These mines had been sending ore to the Central mill of the company, and over 100 men have lost employment as a result of their closing.

▶ Century Zinc Company has suspended operations at its Scott mine and mill late in January releasing about 75 men. A new shaft is being sunk on the lease, and if prices improve the mill will be started again on completion of the shaft, probably some time in March. J. L. Nelson is superintendent for the company.

▶ The Lawyers Lead & Zinc Company reopened its mine and mill on Feb. 12, after being down since early in January. Approximately 80 men were reemployed. George O. Pearson is manager for the company.

IRON COUNTRY

Independent Operators Concerned Over Ore Sales

Transactions between Oliver Iron Company and Ford Motor Company involving sales of iron ore has made producers apprehensive

▶ The Oliver Iron Mining Company's entrance into the iron ore selling business has aroused great interest in the Iron Country. It is believed that Oliver has sold some ore at a low figure to the Ford Motor Company, but at just what price is not definitely known. Independent operators are reported concerned over this announcement, as no one knows how far this policy may go. All the information is a matter of gossip, but no one can conceive of the Steel Corporation adopting any policy that would jeopardize independent iron ore operators. This act has caused the various operators to hesitate concerning new work until they are certain just what the final decision will be.

▶ The usual winter repair work and a few stripping operations are being carried on by most of the various mining companies, and until the Oliver announcement several construction jobs were in prospect such as re-treating plants and new motorized equipment. The Danube mine, of Pickands, Mather & Company at Bovey, Minn. is enlarging the capacity of its washing plant.

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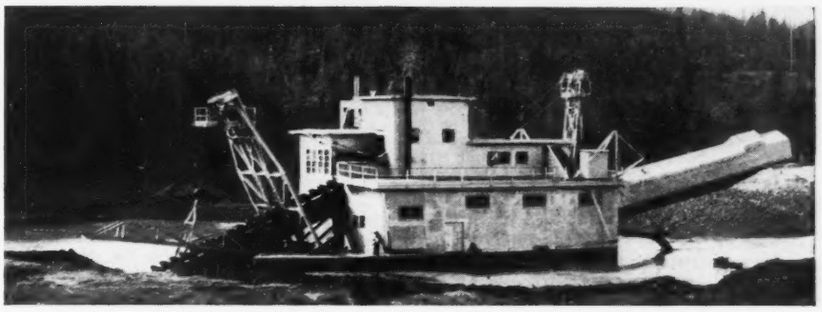

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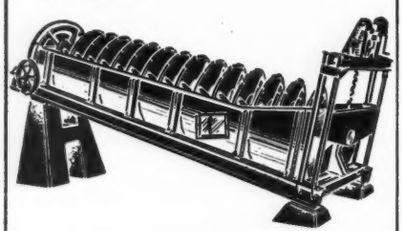

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Surface buildings at the Eldorado Gold Mines near Great Bear Lake, Northwest Territories, where reserves of pitchblende-radium ores have steadily increased. Considerable equipment and supplies are brought in by airplane each year

CANADA

Radium Production Shows Good Increase

Eldorado Gold Mines at Great Bear Lake in North West Territories now producing pitchblende from three veins—Falconbridge Nickel reports increase in ore reserves—Hedley Mascot planning increased mill capacity

▶At the Pitchblende-radium property of Eldorado Gold Mines, on Great Bear Lake, No. 1 shaft has been sunk 800 ft. below the adit, or 890 ft. below the surface. Six levels are established and lateral work extends to three veins. A total of 5,300 ft. has been driven on No. 1 vein, 11,000 on No. 2, and 3,000 on No. 3. All development work is done on a bonus system, and the management reports that efficiency compares well with work on other mines more favorably located. Concentrator capacity is now 100 tons a day. Four James jigs receiving half-inch feed make the initial separation, the concentrate being cleaned on a fifth jig. Jig tailings are reground in a rod mill, the discharge being treated on sand and slime tables, which yield two products each—a finished concentrate and a low-grade product that is retreated on a cleaner table. Flotation is used only when silver-bearing pitchblende is milled. The product is a silver-copper concentrate that is shipped to a smelter. Research to improve milling efficiency has been carried on during the past year. A laboratory method has been developed using flotation to clean pitchblende concentrates produced by gravity processes. Equipment is being brought in by plane this winter to incorporate this practice in the mill operation. The net result will be the removal of most of the sulphides and arsenides and the production of a cleaner and higher-grade pitchblende concentrate. Boiler tests on Fort Norman fuel oil show that it is still too expensive to replace wood. With the completion of the new refinery at Fort Norman, it is expected that a more satisfactory grade of diesel oil will be available at lower cost. The present diesel-electric power plant comprises five units with a total capacity of 1,200 hp. Radium production has passed the 100-gram mark and reserves of pitchblende ore have been increased. A refinery operated by the company at Port Hope, Ontario, 4,000 miles from the mine, has a capacity of 108 grams of radium annually and facilities for processing up to 10,000 tons of uranium compounds. Active research is being conducted to broaden the field of radium as an industrial mineral.

▶ The Yellowknife district is to have its first power plant, according to an announcement by S. G. Blaylock, president and general manager of Consolidated Mining & Smelting Company. A contract has been awarded the Bennett & White Construction Company, Calgary, for a 4,000 hp. hydro-electric plant near Prosperous Lake. This power is to replace diesel engines at the Negus and Con mines, as well as at the Rycon, Ptarmigan, and other properties in the vicinity.

Quebec

▶ In the final quarter of last year Sladen Malartic Mines reduced operating costs from $2.50 to $2.39 per ton. In the same period tailing loss per ton increased from 42c. to 56c. but a way has been found to reduce this loss and the equipment required is to be installed shortly. The mill is treating upwards of 650 tons daily and making a monthly operating profit of better than $30,000. G. H. Robertson is mine manager.

▶ E. V. Neelands, general manager of Canadian Malartic Gold Mines, reports that increased development at the east shaft last year resulted in higher costs and lower operating profit. An orebody 30 to 40 ft. wide and 150 to 200 ft. long is indicated as extending from above the 175 level to below the 475-ft. horizon. Another new orebody, near the main shaft, has been partly outlined by drilling from the 750-ft. level down to 970 ft.

▶ Normetal Mining Corporation, subsidiary of the Mining Corporation of Canada, has entered into an agreement with the British Ministry of Supply for the sale of about 80 per cent of its copper output. Four new levels in the mine are

being prepared for stoping, from 935 ft. down to 1,385 ft. On the bottom level the ore width averages 14 ft. for a length of 653, with a copper content of 3.91 per cent and zinc 2.41 per cent. R. R. Basserman is consulting engineer and J. A. Little mine manager.

Ontario

▶ Deep-level development at Wright-Hargreaves Mines, started last October with the raising of ventilation openings through to surface, is now making satisfactory progress. On the 6,000-ft. level, second deepest at Wright-Hargreaves, drifting has been in exceptionally high-grade ore since the first of January. The old No. 1 shaft is being used as part of the new ventilation facilities. On surface an 80,000-cu.ft. fan has been installed in series with a 60,000-cu.ft. unit at the 3,900 level.

▶ The new sorting plant of Central Patricia Gold Mines will be handling all ore hoisted as soon as the ore pass system is completed, with the result that daily output will be increased more than 50 tons, permitting ore of lower grade to be mined. R. E. Barrett is mine manager.

▶ The annual report of Falconbridge Nickel Mines shows all-time records for ore reserves, production, and earnings. Tonnage treated was almost double the rate in 1935. New ore added to reserves amounted to 1,206,661 tons, equal to more than two years' supply for the smelter and increasing ore reserves to 7,502,000 tons of a grade better than the average mined in 1939. J. Gordon Hardy, president, stated that "concern is naturally felt regarding the possible vulnerability of [the refinery in Norway] under existing war conditions, and much thought has been given towards the cautious safeguarding of this department." The No. 5 shaft has been deepened to 2,529 ft. and a crusher station and loading pocket have been installed, in preparation for opening stopes below the 1,200 level. The ore-pass system has been extended down to the 2,100 level, which is to be used for haulage to the No. 5 shaft. The mine manager is Ernest Craig.

British Columbia

▶ According to D. S. Tait, president, the Privateer mine, in the Zeballos area, experienced minor water trouble in sinking its new shaft. The sinking program will be abandoned temporarily in favor of developing the 1,225 level, lowest in the mine.

▶ A judgment in the protracted litigation regarding the ownership of Zeballos Gold Peak mine was awarded against the original owners and in favor of the company which had made a part payment on the property. It is believed that J. Hammell, of Toronto, Ont., a well-known Eastern operator, is awaiting final settlement of the different claims before he takes any active part in development of this area.

▶ The directorate of the Hedley Mascot Gold Mines, Ltd., in the Similkameen district, has decided to increase the capacity of the company's mill by about 50 tons daily in order that it may handle ore from the adjacent Canty property in addition to ore already being milled

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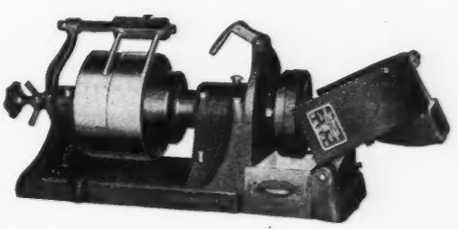

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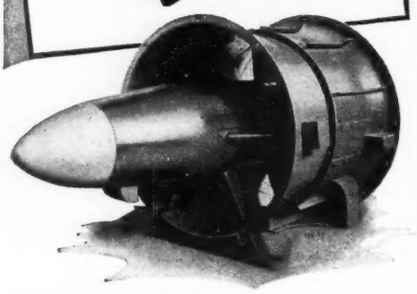

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▶CANADA

from the Mascot. R. R. Stewart, consulting engineer, expects this addition should be made within the next two months.

▶With regard to the Provincial Government's campaign to discover "strategic minerals," some intensive prospecting in the Portland Canal district is being executed. Operations at present suspended owing to the winter will be resumed in the next two to three months.

▶Diamond drilling is in progress at Holland Gold Mines, which is in the same neighborhood as the Pioneer and Bralorne mines. Drilling is being carried out by the Gold Helm Company, a holding company for American interests, registered in the United States. It is anticipated that approximately $50,000 will be expended on this program.

▶Consolidated Nicola Gold Mining Company, Ltd., situated in the Nicola district, has purchased part of the equipment of the Wesko Mines, now in liquidation, in order to complete its mill. According to J. Coates, manager, milling on this property should commence within the next two or three months.

▶A new placer mine, to be operated by the Cariboo Cottonwood Placers, Ltd., composed chiefly of Washington and Oregon interests, is being developed on the Cottonwood River.

▶The Base Metals Mining Corporation, of Toronto, has reopened the Monarch mine, at Field, which has been dormant for some years, in the expectation that, with the higher prices prevailing for lead and zinc and the benefit to Canadian exporters accruing from the fall in the Canadian dollar, it will be possible to dispose profitably of the Monarch concentrates in the U. S. A. Production began Jan. 15 after some 75 men had been employed less than a month in reconditioning the mine and plant. John D. Galloway, recently appointed manager, reports that although early milling will be slow, he anticipates a daily production of 250 tons within a month or less. Considerable underground work has already been done. An orebody approximately 500 ft. long varying from 40 to 50 ft. in width and from 15 to 50 ft. in thickness, with a grade of about 12 per cent lead and 16½ per cent zinc, is indicated, though not proved, in the eastern section of the mine. A reserve of about 3,000 tons of broken ore is ready for the mill.

▶Before closing down early this year, Bayonne Consolidated Mines, in the Nelson mining division, decided to have a geophysical survey made of the mine, the visible ore reserves of which were virtually exhausted. Results of this survey were satisfactory, disclosing two new orebodies, one of which was developed for a length of 179 ft. averaging 1.6 oz. gold over a width of 1.5 ft. Another on which only 10 ft. has been driven, shows promise. It is not yet known, however, whether results of this survey, which will be resumed in the spring, will justify resumption of milling.

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MEXICO

Labor Unions Begin Drive for New Contracts

Large mining units of American Smelting & Refining Company faced with demands for higher wages as agreements with workers come up for renewal this year

▶American Smelting & Refining Company is again confronted with new labor troubles with the demand of the national miners union for revision of work contracts at its Santa Barbara, Avalos, and Parral units, Chihuahua, Nueva Rosita, Coahuila, and Los Morales, San Luis Potosi. The union asserts that the contracts are unsatisfactory. Higher wages are said to be among the principal demands.

▶Asarco has started a court presentation in Mexico City to prove that it cannot comply with the orders of the Federal Board of Conciliation and Arbitration that it must continue operating its copper smelter at Matehuala, San Luis Potosi. The company presented proofs of its contention to the court that this plant cannot continue operation, due to a lack of ore.

▶Resolutions calling for free minting of silver, suppressing the 5-peso banknotes, and calling a Pan American conference as means of aiding the white metal, and greater government action to curb thefts of ore from companies and individual miners, were adopted at the third annual convention of small-scale miners in Mexico City, Jan. 29 to Feb. 4. The meeting was under the chairmanship of Ing. Genero P, Garcia, president of these

miners' association. It was attended by some 600 delegates and representatives of the federal government and those of the mining states. It was said at the convention that thefts of ore by bandits and alleged prospectors is causing the industry such heavy losses that if this pilfering is not curbed it will ruin some companies and most small-scale workers. The national miners union denied charges made at the meeting that laziness of miners has alarmingly decreased production. Various factors other than labor enter into mining production, the union declared. The Ministry of Finance is reported to be opposed to the proposition of suppressing the 5-peso banknotes.

▶The French-owned Cia. Minera Dos Estrellas, El Oro, State of Mexico, has arranged to sell its properties to the workers, who took charge of them about 18 months ago and have been running them since cooperatively, for 3,900,000 pesos (some $650,000), payable at the rate of $5,000 (U. S.) a month. The cooperative asserts that it is running these properties profitably. The owners quit because they found the work unprofitable.

▶ Higher pay, though making things better for miners of the Angangueo district, Michoacan, has resulted in a sharp decrease in production, for the workers no longer work with a will, say owners of these mines, who have complained to the Federal Labor Department. These miners were recently granted a considerable pay increase after long agitation by the national miners union.

▶ Workers of Cananea Consolidated Copper, Cananea, Sonora, suffering from silicosis are being investigated and aid is being provided for them by a committee comprising William Gooch and Enrique Nieves, for the company; Salvador Portugal and Lic. Ignacio Ortega, for the workers, and Lic. Efrain Ramirez de la Cueva, for the Federal Labor Department.

▶ Success that is manifested by production valued at 15,000,000 pesos (about $3,000,000) and prestige of its members among the miners of Mexico, since it assumed charge of the property in June, 1937, is claimed by the cooperative society that is operating the British-owned Cia. Minera Dos Carlos, S. A., Pachuca, Hidalgo, in a testimonial of gratitude to President Cardenas and his government and the government of Hidalgo for "the sympathetic and prompt assistance they have rendered us." The society brands as false reports that it tried to conceal facts about the accident in its Barron mine in which nine men were killed and three others injured. Federal inspectors found that the accident was caused by carelessness and inefficient operation and ordered the society to install adequate safety devices.

Finland

▶ Recent reports from the Petsamo area indicate that the Russian invaders are working at top speed with the aid of German engineers to bring the nickel deposits 50 miles south of Petsamo in northern Finland into production as soon as possible. (See *E.&M.J.* December, 1939, p. 86).

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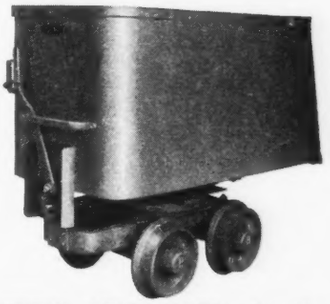

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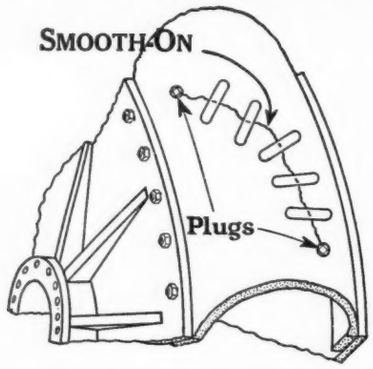

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AFRICA

Gold Buying Policy May Be Changed in South Africa

Full market price of 168 shillings may be obtained if plan of Minister of Finance and Education is approved

▶According to a news dispatch from Capetown by Reuters it was reported late in February that gold producers on the Rand might receive the full price of 168 shillings per ounce instead of the 150 shillings now being paid. This was announced on February 28 in the Assembly of the Union of South Africa by J. H. Hofmeyr, Minister of Finance and Education. The announcement was made as Mr. Hofmeyr presented his war budget to the Assembly, in which he announced the introduction of an excess profits tax of 10 shillings in the pound (50 per cent). Because of special provisions made in connection with the changed gold price policy, the new tax will not apply to the gold mining industry.

In addition, he proposed to impose on the gold mining industry a special contribution of £3,500,000 which would be complement to the excess profits duty. He devoted part of his address to the effect of the war upon gold mining, South Africa's major industry, and the need for modification of policy to offset certain adverse effects which have set in. At present, the Minister pointed out, there are four large mines on the Witwatersrand which are in danger of closing within the next fifteen months unless the mining of lower grade ore is stimulated. Any reduction in the amount of gold produced in South Africa would mean a reduction in the amount of new gold available to the British Empire to finance war purchases. By departing from the fixed price, he said, a considerable stimulus would be given to the working of lower-grade ore.

▶East Daggafontein plans to increase its reduction plant to a capacity of 80,000 tons per month, against 60,000 tons at present. Ore reserves are estimated as 2,301,000 tons averaging 6.24 dwt. per ton.

▶Western Holdings has exercised another option for the purchase of mineral rights, purchasing those of Farm Vlakplaats No. 667, in the Orange Free State. It is believed that this and previous purchases are preliminary to the forming of a working subsidiary company. Thus it becomes more and more apparent that the country may see gold being produced from the Witwatersrand formation over a lateral distance of over 200 miles. This will make it one of the greatest of the world's continuous metalliferous belts, adding to the distinction of being many times the greatest gold belt so far discovered.

▶It has been rumored recently that the British Government will shortly revise its agreement with the Rhodesian copper mines and pay them a somewhat higher price for their copper. The present price, said to be about £46 per long ton for blister, and ability to produce at full

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capacity, are probably giving the companies about the largest net earnings of their career, as they have enjoyed hitherto only a short period of higher prices. Roan Antelope and Mufulira will hereafter issue half-yearly reports, the same as Rhokana, it having been decided to discontinue making quarterly statements.

India

▶ The plans seemingly made two or three years ago for an obituary for the Burma Corporation were premature. Last year the company mined 485,115 tons of ore, and additions to reserves by new development replaced all but 156,713 tons of this. Reserves now amount to 3,607,945 tons, or over seven years' supply. Last year's operations made a rather unfavorable showing, due to lower-grade ore being treated and the low prices for metals which ruled; but production costs were reduced and ocean freight rates were lower. A decrease of Rs.17,88,645 in net earnings was accounted for chiefly by increased taxation, economies having almost wholly offset low metal prices and decreased yield. The average grade of the ore reserves is practically unchanged.

British Isles

▶ Polberro Tin, the company which, having purchased an abandoned Cornwall mine, cleaned out the old shaft and miraculously found it bottomed in 3½ per cent tin ore, has carried out a development program with varying results. The richness first discovered did not persist, but a good amount of ore has been opened up. The consulting engineer has decided that the mine can now be depended on to supply 50 per cent of the amount of ore continuously that the available milling capacity can deal with, and production will be started forthwith. Arrangement has been made for £30,000 of additional cash with which to continue development work. The influence of this company's discovery, together with the war and the high price of tin, seems likely to cause a general revival of mining activities in Cornwall.

AUSTRALIA

Magnesite Deposit to Be Developed

Property in Western Australia will supply Newcastle Steel Works—Maude and Yellow Girl Gold Mining Company plans larger mill

▶ Known since 1914, but so far without a market, a magnesite deposit at Bulong, 20 miles from Kalgoorlie, has been pegged out by the Broken Hill Proprietary Company to augment the supplies of this mineral for its Newcastle steel works. The deposit is estimated to contain 1,000,000 tons of high-grade material.

▶ R. E. Binns, consulting engineer to

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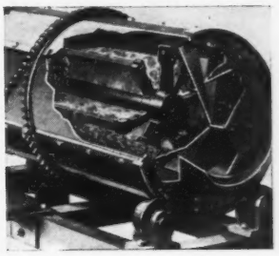
ROTARY AMALGAMATOR

May be easily and quickly installed in
Your Recovery System

RECOVERS ALL THE FREE GOLD
As high as 98% recovery reported



MAINTENANCE COST VERY LOW
QUICK CLEAN-UP

Core can be removed, plates cleaned and replaced ready to run in 32 minutes or core can be withdrawn and replaced by spare core ready to run in 8 minutes.

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MANUFACTURERS
The best in Recovery Equipment
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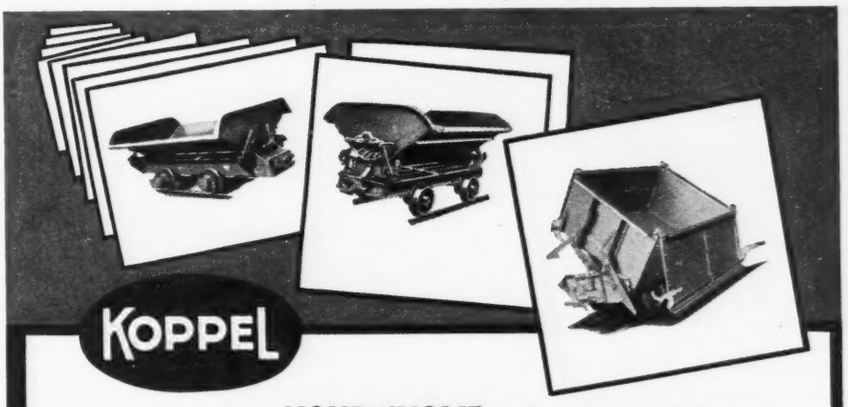

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20 Different Types of
SIDE DUMP CARS

The Koppel line, largest and most modern in the world, contains over 20 different types of Side Discharge Cars. Illustrated above are three typical types.

Koppel cars are designed and built by engineers with many years of experience. Strong, well designed and sturdily built, these cars will give you top performance wherever they're used.

Side Discharge Cars, as well as all the Koppel types, are fully described in our Bulletin No. 71 sent on request.

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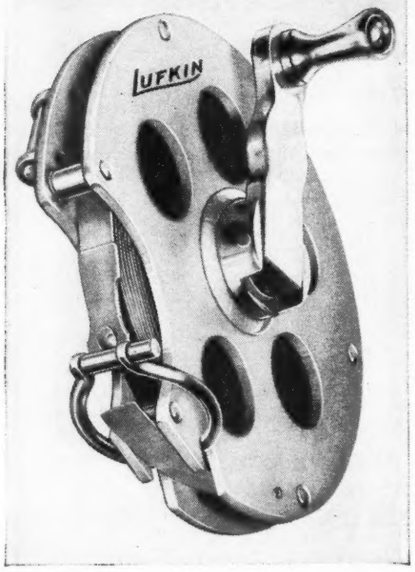
FOR UTILITY



"WOLVERINE"
STEEL TAPES
wear longer

Because the Lufkin "Wolverine" is such a practical Steel Tape, it is a favorite with civil and mining engineers everywhere. The line, of highest grade tape steel is ¼-inch wide, flexible and most durable.

Markings are clear and guaranteed accurate. The light-weight, rust-proof disk reel is perforated to aid in clearing tape of dirt. Winding handle will lock tape at any point and provides good leverage for fast, easy winding. Adjustable leather strap handle allows firm grip. See your dealer and write for complete catalog.

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SAGINAW, MICHIGAN · New York City
TAPES · RULES · PRECISION TOOLS

▶AUSTRALIA

the Wiluna Gold Corporation, Ltd., estimates the life of the Wiluna mine, with reasonable safety, as 30 months from March 31 last. He considers that 1,200,000 tons of ore can be mined and treated. Although the Happy Jack area will probably supply a substantial tonnage, it is not of the importance that was believed originally and will be far from sufficient to save the mine.

Victoria

Experiencing a combination of drought conditions which persisted over five months of the year, and the treatment of poorer ground, Cocks Eldorado Gold Dredging, N. L., Eldorado, had a much reduced net profit for the year ended Sept. 30, £23,797 Aust. as compared with £71,711 for the preceding year.

▶ Ore reserve of Maude and Yellow Girl Gold Mining Company, Glen Wills, has been increased to 70,000 tons averaging 9 dwt., sufficient, it is considered, to justify the replacement of the present plant by a more up-to-date unit. The new mill will have twenty stamps and is estimated to treat 20,000 tons yearly, as compared with the 8,000 tons of the existing plant.

▶ Two interesting developments have occurred recently at Bendigo. Central Nell Gwynne Gold Mining Company has encountered in shaft sinking, at a depth of 1,350 ft., what is believed to be the South Nell Gwynne reef, which in the adjoining Nell Gwynne (B.M.L.) mine to the south was of large size and had profitable spurs associated with it. In the North Nell Gwynne, on the same anticline, gold has been met with in cross-cutting at 1,300 ft.

▶ North Deborah Gold Mining Company N.L., Bendigo, the most recent success of the Bendigo field, recently purchased the ten-head mill of the North Blue company at a cost of £5,250.

Queensland

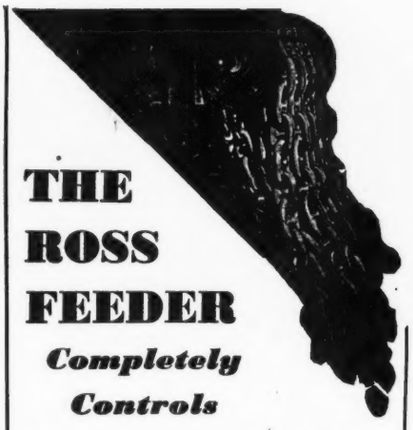
▶ Tableland Tin Dredging, N.L., Mount Garnet, has decided to go ahead with the construction of its large dredge, and quotations have been called for. The capacity, it was announced some time ago, is to be 350,000 cu.yd. monthly, and the estimated cost is £140,000 Aust. plus £10,000 for water storage.

New South Wales

▶ Previously scheduled to cease operations on Dec. 22, the Central mine, Broken Hill, owned by the Sulphide Corporation, will resume operations after the year-end shutdown on Jan. 9.

▶ Glen Innes Dredging N.L., Glen Elgin, during the year ended Sept. 30 treated 616,700 cu.yd. of wash and produced 2,060 oz. bullion and 27.5 tons of tin concentrate. Both values and yardage in the area worked proved to be below expectations, but results are now improving.

▶ New Occidental Gold Mines, N.L., Cobar, treated 137,299 long tons of ore during the year ended Nov. 30, producing 48,123 fine ounces of gold and 505 tons of copper concentrates.



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High in efficiency. Low in maintenance and power consumption.

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NEW BOOKS

INDUSTRIAL HEALTH—ASSET OR LIABILITY. *By C. O. Sappington, M.D. Published by Industrial Commentaries, Chicago, Ill. Pp. 224; and 24 model examination forms. Price $3.75.*

WRITING out of his experience of 25 years as a consultant to a large number of industrial firms and insurance companies, the author produces a volume of practical use for the business executive and the industrial medical practitioner. It demonstrates the practicability of improved industrial health in terms of dollars and cents, and shows the procedures necessary to develop and maintain an effective industrial health program. The volume lives up to its title, dealing with industrial health as a business proposition, showing that, good or bad, it will prove either an asset or a liability.

PRESENT STATUS AND TRENDS OF ENGINEERING EDUCATION IN THE UNITED STATES. *By Dugald C. Jackson. Published by the Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y.*

MADE POSSIBLE by a generous contribution from the Carnegie Foundation for the Advancement of Teaching, this report is an analysis of the wealth of factual information obtained by the Committee on Engineering Schools of E.C.P.D. in surveying 679 engineering curricula in 138 institutions. In the first few chapters of the report Dr. Jackson briefly summarizes three earlier studies of engineering education and traces the history of developments that led up to the accrediting program of E.C.P.D. One chapter is devoted to a statistical and graphical analysis of the committee's data, and another to a discussion of a score of observable current trends in engineering education. The report is of exceptional interest and value to all concerned with engineering education.

CANADIAN MINES HANDBOOK, 1940. *Northern Miner Press, Ltd., Toronto, Canada. Pp. 272. Price $1.*

USEFUL to all who have any interest in Canadian mines is this revised annual, listing and giving pertinent information about mining companies in the Dominion. Nearly 900 mining organizations were active at some time during 1939, and nearly 200 new companies were formed and started operations. Information on operating companies includes addresses of head office and mine office, names of directors and operating officials, capitalization, history, location, and development. Production and dividend records are included.

▼ ▼ ▼

PUBLICATIONS
RECEIVED

"Introduction to Electrical Machines" (a textbook). By A. W. Hirst. Chemical Publishing Company, 148 Lafayette St., New York. Pp. 122. Price $2.25.

"The Book of Diamonds." By J. Willard Hershey. Hearthside Press, Chemical Publishing Company, 148 Lafayette St., New York. Pp. 142. Price $2.

Flotation Reagents. No. 7, Second Edition, January, 1940, of "Ore Dressing Notes," published by American Cyanamid Company, 30 Rockefeller Plaza, New York. Pp. 29.

Flotation Index. A bibliography of articles on flotation prepared from the year 1928 up to January, 1939. Compiled by Great Western Division, Dow Chemical Company, 9 Main St., San Francisco. Pp. 61.

Grades of Lake Superior Iron Ores Shipped by Lake (Cargo Bill-of-Lading Weights). 1939 Season. Issued by Lake Superior Iron Ore Association, 1170 Hanna Bldg., Cleveland, Ohio. Pp. 4.

Nevada Bureau of Mines and Mackay School of Mines, Reno, Nev., have jointly issued the following: "Nickel Deposits in Cottonwood Canyon, Churchill County, Nevada," by H. G. Ferguson, price 25c., pp. 24; and "Goldbanks Mining District, Pershing County, Nevada," by R. M. Dreyer, price 30c., pp. 38.

Metallurgical Research.. Annual Progress Report (Report No. 9), State Electrometallurgical Research Laboratories. By A. E. Drucker, State College of Washington, Pullman, Wash. Pp. 23. This contains matter bearing on work with magnesium, manganese, and chromium; also on the electric power situation in the Bonneville Dam area.

Geology of the Searchlight District, Clark County, Nev. Bulletin 906-D. Pp. 135 to 188 inclusive. U. S. Geological Survey. Sold by Superintendent of Documents, Washington, D. C. Price 40c.

Bureau of Mines, Washington, D. C., has issued: "Annual Report of Metallurgical Division, Fiscal Year, 1939," by R. S. Dean (Report of Investigations 3480), pp. 98. Also Information Circular 7093, "Reconnaissance of Mining Districts in Churchhill County, Nev.," by W. O. Vanderburg, pp. 57. Also Information Circular 7094, "Mining Methods and Costs at the South Burns Shaft of Golden Conquerer Mines, Inc., Cripple Creek, Colo.," by A. S. Konselman, pp. 13. Also Information Circular 7097, "Strategic Minerals Investigations Procedure Followed by the Bureau of Mines," by John W. Finch. Also Report of Investigations 3483, issued by Metallurgical Division and dealing with the recovery of nickel, copper, and precious metals from domestic ores by a combined electrothermal and electrolytic method, by J. Koster, R. G. Knickerbocker, O. C. Garst, T. E. Evans, and W. E. Cody.

Quebec Bureau of Mines, Quebec, P. Q., has just issued Part D of its annual report for 1936, dated 1938. This contains two papers: on "Mount Alexander Map-Area, Gaspe Peninsula," by I. W. Jones, and on "Sainte-Anne River Map-Area, Portneuf County," by J. W. Laverdiere.

Dominion Bureau of Statistics, at Ottawa, Canada, has issued: "The Talc and Soapstone Industry in Canada, 1938," price 15c.; also "The Mica Industry in Canada, 1938," price 25c.; also "Iron Oxides (Ochre), 1938," price 15c. Also "The Asbestos Industry in Canada, 1938" (including the asbestos mining industry and the asbestos products industry), price 15c.; also "The Feldspar and Quartz Mining Industry in Canada in 1938" (including data on nepheline-syenite), price 25c.; also "The Miscellaneous Non-metallic Minerals in Canada, 1938," price 25c.; also "The Salt Industry in Canada, 1938," price 10c.

Australasian Institute of Mining and Metallurgy Proceedings, No. 116, New Series, Dec. 30, 1939, containing following papers; "Roasting and Treatment of Auriferous Flotation Concentrates," by A. F. B. Norwood. "Milling Methods and Costs at Mount Isa Mines, Ltd.," by J. Kruttschnitt, L. K. Jacobsen, and K. B. Gross. "Mineralogy of the Black Star Orebody and Its Relation to Milling Practice at Mount Isa," by G. B. O'Malley and R. R. McGhie. "An Analysis of the Deformation and Hardening of Lead Effected by Rolling and Pressing," by H. K. Worner. "The Practice of Mine Ventilation in Western Australia," by E. E. Brisbane. "Pulp Sample Divider," by C. E. Kennedy-Smith.

Western Australia. Statistical Register for 1938–39 and previous years. Part VII, Mineral Statistics and Water Conservation. By S. Bennett, Government Statistician, Perth. Pp. 15.

South Australia. "The Pre-Cambrian-Cambrian Succession. The General and Economic Geology of these Systems, in Portions of South Australia." By R. W. Segnit. Bulletin 18, Geological Survey of South Australia, Adelaide, South Australia. Pp. 191. A large number of geological maps and sections in color and halftone plates are bound in this volume. Among the mining areas, the geology of which is described, are the Mount Grainer gold field, the Burra Burra mines and district, the Mongolata gold field, the Kapunda mines and district, and the Andamooka opal field.

South Australia. Mining Review for the half year ended, June 30, 1939. No. 70. Department of Mines, Adelaide. Pp. 92, including folded-insert table of mineral statistics.

India. Annual Report of the Chief Inspector of Mines in India, 1938. Published by Manager of Publications, Delhi. Pp. 202, including numerous folded maps, charts, and other drawings. Price 4s. 3d.

Tanganyika Diamonds. "The Kimberlite Province and Associated Diamond Deposits of Tanganyika Territory," by G. J. Williams. Bulletin 12, Geological Division, Department of Lands and Mines, Dar es Salaam, Tanganyika Territory, Pp. 41. Price 3s.

Statistical Summary of Mineral Industry of British Empire and Foreign Countries. 1936–38 Edition. Published by Imperial Institute, South Kensington, S. W. 7, England. Pp. 453.

The Mexican Oil Seizure. By Donald R. Richberg. Received from the President's Office, Standard Oil Company (N. J.), 30 Rockefeller Plaza, New York. Pp. 56.

Present Status of the Mexican Oil "Expropriations," 1940. Published by Standard Oil Company (N. J.), 30 Rockefeller Plaza, New York. Pp. 173.

Bolivia. Bulletin of Mines and Petroleum, Vol. I, No. 1, December, 1939. Issued (in Spanish) by Ministry of Mines and Petroleum, La Paz. This initial number contains the following articles: "Development of Antimony (Industry) in Bolivia and Its Future Possibilities," by Charles Will Wright. "Tin Reserves in Bolivia (from the geological viewpoint)", by Federico Ahlfeld. "On the Concentration of Gold in the 'Boxed-in' Rivers," by Raul Canedo Reyes, "Cia. de Minas de Colquiri," (descriptive), by H. I. Altshuler. "General Features of the Mineral Economy and Its Most Pressing Problems in Bolivia," by Formerio González. An appendix containing export statistics and "supreme decrees" relative to mining is included. Pp. 68.

Brazil's National Department of Mineral Production. Division of Geology and Mineralogy, Rio de Janeiro, has issued the following, in Portuguese: "Annual Report of the Director (of the Division), 1937," by Euzebio Paulo de Oliveira, pp. 112. Also Bulletin 90, "Geology and Hydrology of Northwest Bahia," by Jose Lino de Mello Junior. Also Bulletin 91, "Geology of Lower Amazonas," by Pedro de Moura, pp. 94, plus map. Also Bulletin 94, "Geology of Southern Goyaz," by A. I. Erichsen and João Miranda, pp. 60, plus maps and photographs. Also Bulletin 101, "Geology of the 'Faixa Subandina' of Bolivia," by Glycon de Paiva, Jorge Muñoz Reyes, and Guillermo Mariaca M., pp. 83, plus maps. Also "Occurrence of Cinnabar in D. Bosco, Minas Geraes," by Evaristo Penna Scorza. Pp. 16, plus map.

Stop Unnecessary Track Expense

Moving ahead or shifting to either side of the loading track is easy with the crawler mounted shovel. It will turn in an eight foot circle.

Crawler mounting simplifies track laying problems

With the crawler shovel, there is no need for laying substantial track as the job advances. By using temporary slip rails for handling cars only, much expense and time required for track work is eliminated. The crawler mounted shovel speeds up the time getting into action, cleans up fly dirt faster, and digs below track level, thus eliminating much hand shoveling. For greater speed and lower costs, put this crawler mounted shovel to work on your underground loading jobs.

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NORDBERG-BUTLER UNDERGROUND SHOVEL

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ZINC DUST

Because of its increased efficiency, Merrillite is preferred. A highly refined zinc dust, of extreme fineness and always uniform.

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The *Strongest* part is the spiral seam . . . and there is PLENTY OF SPIRAL

IT'S the spiral *lap* reinforcement that gives spiral pipe strength beyond that of any pipe of its weight—and in Taylor Spiral Pipe the pitch of the seam is carefully calculated for each group of sizes to give the proper structural strength for the particular pipe diameter. It is never more than 24", lap to lap, and in some sizes and weights the laps are as close as 9". Taylor Spiral Pipe is available in thicknesses of No. 16 to No. 8 gauge —sizes 3" to 42"—lengths to 40 feet —protective coatings of all kinds—end joints for all mining services. Ask for 42 page catalog.

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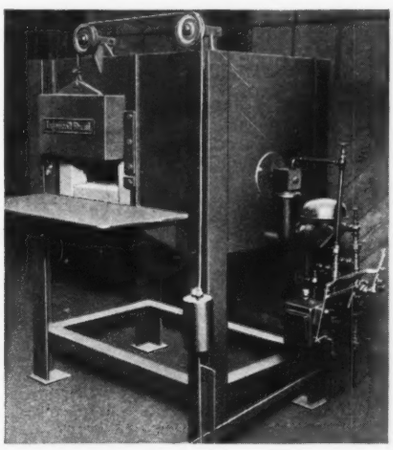
EQUIPMENT NEWS

Heating Detachable Bits

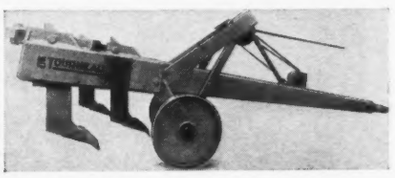
INGERSOLL-RAND Company, Phillipsburg, N. J., announces the new "Jackfurnace" for the rapid heating of the company's detachable rock drill bits known as "Jackbits." Designed especially for the servicing of Jackbits, it can be used with either Jackmills (hotmills) or grinders. It can also be used for heating shanks and rod ends for hardening. Low-pressure air from an induction blower passes through a pre-heating chamber before entering the burner, thereby aiding combustion and increasing efficiency. Convenient controls enable the operator



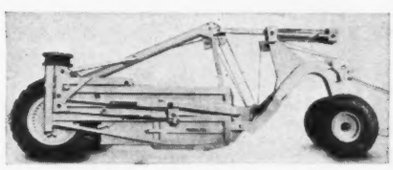
to attain the proper mixture of oil and air. The furnace can be equipped with an automatic temperature-control device. When heating Jackbits for re-hardening, the Jackfurnace is said to handle approximately 180 Jackbits per hour. It is said to be well insulated to insure low room temperature for the operator. The manufacturer furnishes, as standard equipment, a loading spoon and an unloading device to facilitate the handling of Jackbits to and from the furnace.

Carryall Scraper

TO MEET the increasing demand for a scraper that will handle more "pay dirt" per pound drawbar pull, R. G. LeTourneau, Inc., Peoria, Ill., has designed and placed on the market a new, double-bucket, cable-controlled Carryall Scraper —the SU—rated at 14 cu. yd. struck capacity and 18 heaped. The scraper is designed to give maximum capacity for loading under normal conditions without the aid of a pusher and thus completely to utilize tractor power. Positive mechanical ejector tailgate is said to completely remove contents from bowl bottom and sides even when operating in wet and sticky material under adverse working conditions. This same positive load ejector controls the measured spreading of material from 1 in. to 16 in. All dirt is pushed out the apron opening in front to eliminate void in fills.

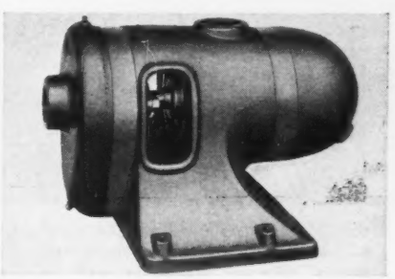


To speed Carryall scraper production, eliminate blasting, and extend scraper efficiency into rock, shale, and hardpan, the company also announces its new Rooter said to be the largest, heaviest, and strongest of its kind ever built, known as the 9150 lb. Extra Heavy Duty K3. The new Rooter comes equipped with three teeth which have a maximum depth of 28 in. Each is removable to meet job conditions and ideal fragmentation. The center of the three teeth is set ahead of the others to gain quicker penetration in the hardest material. To give easier penetration and keep the teeth feeding into the material, the ends of the rooter shanks are built at a steeper angle than formerly employed on rippers. Hard-faced, self-sharpening teeth, shaped for natural digging suction, fit like caps on the end of the shanks and are reputed to give long life and faster, easier rooting.



Pump and Motor Unit

FEATURING the combination of a fully inclosed, self-protected, electric motor with centrifugal pump in a single, compact frame, the new Smithway centrifugal pump is now available, according

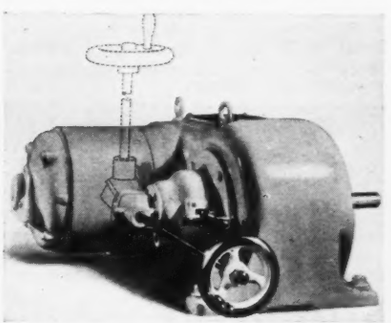


to the Smith Meter Company, 5743 East Leneve Street, Los Angeles., Calif. The pump is said to provide in one compact unit a smaller size-to-power and a higher power-to-weight ratio than any other motor operating on a standard cycle three-phase current. The pump frame is said to be so constructed that water or other liquid being handled is passed around the thin tubular shell of the motor, providing definite and continuous cooling. The design and construction of the unit are said to offer advantages over the conventional type pump assembly, such as predetermined operating temperatures, assuring maintenance of motor capacity, continuous cooling, fully inclosed, and moisture-, shower-, dust-, splash-, and drip-proof features. The unit mounts in any position.

Flexible Motor Controller

A NEW SINGLE, right-angle, mechanical remote control for Varidrive motors was recently announced by the United States Electrical Motors, Inc., Los Angeles, Calif. This control is said to provide an accurate, simple means of selecting the desired operating speed of the Varidrive motor when the Varidrive is mounted beneath or above the driven machine or is otherwise inaccessible.

The control shaft may be extended at a 90-deg. angle in any one of eight dif-



ferent directions. An inclosed set of helical right-angle gears makes this possible. This right-angle remote control permits the hand wheel to be placed within easy reach of the operator so that the exact desired speed can be maintained without difficulty at all times.

The Garlock Packing Company, Palmyra, N. Y., announces its Flange-Jacks, a new tool for replacing gaskets in flanged pipe lines. The jaws of this tool are said to be made from heavy one-piece steel forgings capable of withstanding tremendous pressure and easily operated. There are three sizes: 2-in. pipes and under; 2- to 20-in. diameters, and the large size for 14- to 48-in. pipes.

Try THE NEW ACID-PROOF DURAKLAD FILTER CLOTH

A NEW FABRIC WOVEN FROM SYNTHETIC PLASTICS

Here is a new filter cloth that makes possible new efficiencies—greater economies.

The synthetic fibre from which it is woven is highly acid resistant—no fuzz or lint—require less frequent washings—highly mildew resistant—give 50% to 300% longer wear.

Victor Filter Fabrics are made in over 100 constructions. Widths from 18" to 120". Weights from 8 oz. to 50 oz. square yard. Include Ducks, Twills and chain cloth for metallurgical use.

Sold by the yard or cut and sewed to fit all types filters.

Large stocks carried for prompt deliveries.

Write for more information. Samples sent promptly upon request.

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Success Formula

The SuperDuty No. 6 Deister-Overstrom Concentrating Table, utilizing our exclusive and efficient Diagonal Deck design answers all requirements. It is a complete new machine offered as the highest class job available today. Treats slimes as fine as minus 400 mesh and sands thru the entire range—as coarse as 5/8" on some ores.

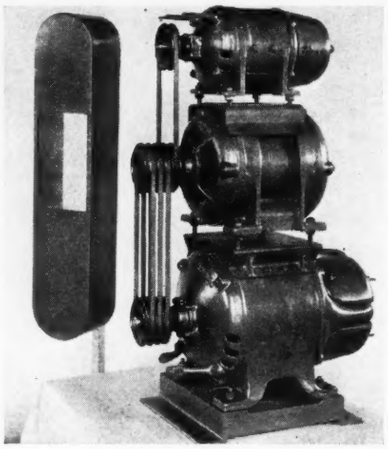
The new Concenco Anti-Friction Bearing Head Motion guarantees record performance. Novel features of this operating mechanism produce a differential kick that nets better metallurgical separation and far greater tonnages.

These modern tables can save you money! . . . . . Write now—for details and prices—no obligation!

The Deister Concentrator Company
The Original Deister Company
Incorporated 1906
903 Glasgow Ave., Fort Wayne, Ind.

New Pyramid-Mounted Motor-Generator Set

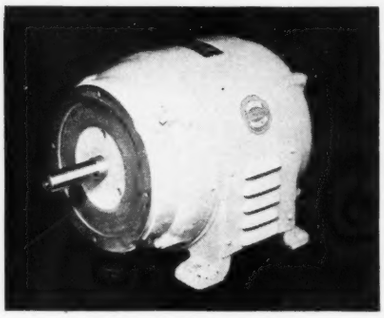
SAVING in floor space, accessibility, and the use of machines of different speeds are outstanding features of a new Pyramid-Mounted arrangement of three-machine motor-generator sets developed at the Norwood, Ohio, Works of Allis-



Chalmers Manufacturing Company. The generator, motor and exciter, each a self-contained machine, are assembled one above the other, thus requiring floor space equal only to the generator mounting dimensions. On top of the generator is placed the induction motor, securely attached with suitable base plate, and the exciter in like manner is mounted on top of the motor. The generator and exciter are driven by Texrope V-belts from the motor shaft, adjustment being provided in the motor and exciter base plates. Motor-generator sets of this type are at present available in sizes up to and including 10 kw.

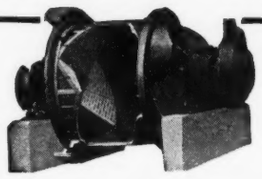
Rotary Roasting Furnace

COTTRELL Engineering Company, 207 Mesnager St., Los Angeles, Calif., announces a new line of rotary roasting furnaces, especially designed for treating quicksilver ores. Officials claim that compact design and sturdy construction assure continuous operations, low main-



United States Electrical Motors, Inc., 80-34th St., Brooklyn, N. Y., announce that their motors are now available with unimount end shields. These end shields have a flat surface to facilitate the mounting of pumps and other directly driven equipment and for mounting magnetic brakes. They may be assembled on either end of the motor and can be used to mount a footless motor to a machine frame if desired.

WILLIAMSON MILLS



EVER HEAR THIS BALL MILL STORY?

Man about to buy a mill: "What's so different about this Williamson Mill?"

Williamson Mill Operator: "Its operating cost."

M.A.T.B.A.M.: "You mean there's a saving?"

W.M.O.: "Certainy—over 20%."

M.A.T.B.A.M.: "Power, balls or what?"

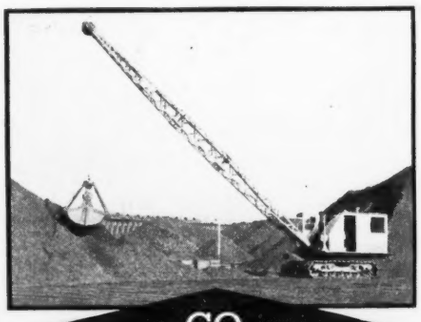
W.M.O.: "Everything—power, balls, liners—20% per ton of ore ground."

M.A.T.B.A.M.: "Why?"

W.M.O.: "There's more grinding action. It's the only mill designed to lick slippage which is d————d important in saving power and maintenance costs. Why don't you write Williamson for the lowdown?"

"It's the shape of the drum that does it."

WILLIAMSON COMPANY
582 Market St. San Francisco, Calif.

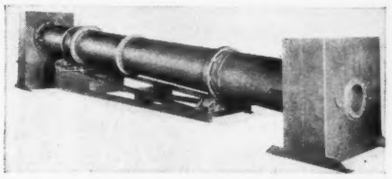


GO WHERE THE WORK IS

Bucyrus-Erie clamshells are not tied down to tracks but can go anywhere in your yard. They can unload material from boats and stock-pile it, load from stock-piles to hoppers or direct to cars and trucks. They're ready, at a moment's notice, to go where you need them. And they have the speed and control to work fast when they get there. Ask us to show you how one of these modern machines can save you money.

BUCYRUS-ERIE CO.
SOUTH MILWAUKEE, WIS., U. S. A.

tenance costs, and low fuel consumption. Two units are being placed on the market. The roasting furnace shown in the accompanying illustration measures 30 in. by 30 ft., complete with firing and feeder hoods, and handles about 25 tons

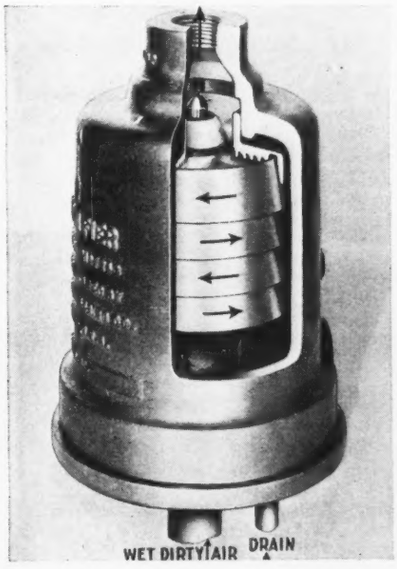


of material a day. The second unit, 3x40 ft., is designed to feed either concurrently or countercurrently, as desired. It is supplied with angle-iron frame, firing and feeder hoods, and, as the smaller furnace, can be equipped with either a rotary or bump feeder.

Moisture Remover

LOGAN Engineering Company, 4912 Lawrence Ave., Chicago, Ill., announces that its line of Aridifiers for removing moisture and oil from air and gas lines is now complete in all sizes from ⅜ to 10 in.

All sizes are said to effectively remove dirt, scale, oil, and moisture from com-



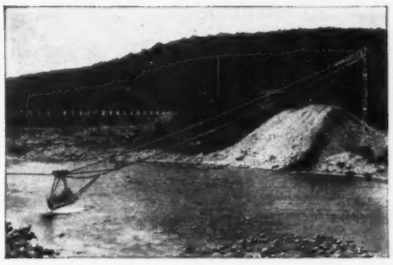
pressed-air lines and gas lines, foreign matter impinging on a multiplicity of "propeller blades" revolving in opposite directions and propelled by the flow of air or gas. The arrested contamination and moisture is collected in the lower housing from which point it is drawn off as occasion warrants.

Monobloc Pump

A NEW balanced Monobloc centrifugal pump, wherein the motor and pump have been engineered as an integral unit of balanced functional design in contrast to merely adapting a motor to a pump, is just announced by the Worthington Pump & Machinery Corporation, of Harrison, N. J. This new pump requires a minimum of floor space, yet is provided with ample room for repacking the stuff-

Big Savings
. . . IN HANDLING MATERIALS

Sauerman Drag Scrapers handle indoor storage of coke, bauxite and pitch in three large storage buildings at aluminum refinery.



Sauerman Slackline Cableway digs boulders and hardpan to clean out a 1-mile tailrace and increase the head of water for a hydroelectric plant.

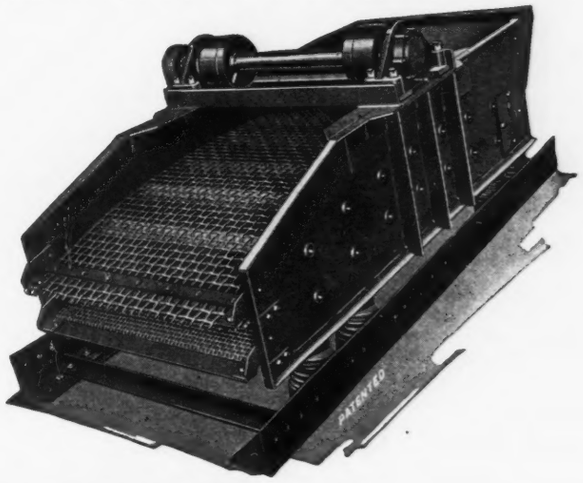
Open pit mining, storage and reclamation of both raw and processed minerals, and similar work that calls for moving materials distances of 100 ft. or more, are accomplished most economically with Sauerman Cableway or Scraper machines.

A Sauerman machine shows lower costs on these long range material-handling jobs because it digs, hauls, and places the materials in a continuous, straight-line operation, doing away with the expense of rehandling.

Write for catalog

SAUERMAN BROS., INC.
484 S. Clinton St., Chicago

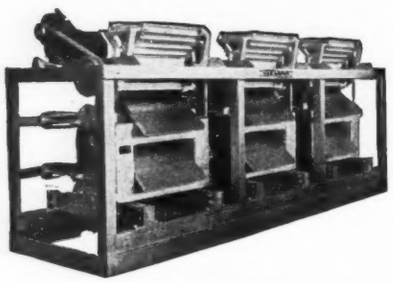
DEISTER PLAT-O VIBRATING SCREEN FOR ORE



1. Powerful high-speed vibrating mechanism.
2. Screen cloth automatically held under uniform tension.
3. Any one screening surface changed without disturbing remaining decks.
4. Cushioned vibration.

DEISTER MACHINE CO.
1933 E. Wayne St. Ft. Wayne, Ind.
Canadian Licensee and Manufacturer:
Manitoba Bridge & Iron Works, Ltd., Winnipeg

Stearns
MAGNETIC
FOR
EFFICIENT
SEPARATION
OF SO-CALLED
NON-MAGNETIC
MATERIALS



STEARNS TYPE "K" HIGH INTENSITY MAGNETIC SEPARATOR

If you have a problem in purifying and concentrating of such material as feldspar, glass sand, clays, gypsum, kyanite, mica, borax, apatite, barytes and silica, investigate STEARNS Magnetic High Intensity Type "K" separators.

Provide powerful, concentrated magnetic field, lower power input, correspondingly lower power consumption, flexibility arranged for multiple magnetic zones to suit requirements. Particularly suitable for materials heretofore considered unresponsive to such separation.

Make use of our extensive laboratory facilities. Send us 25 to 50 lbs. of your material express prepaid for test, suggestions and recommendations.

WRITE FOR OUR DESCRIPTIVE LITERATURE ON HIGH INTENSITY MAGNETIC SEPARATORS

STEARNS MAGNETIC MANUFACTURING CO.
624 S. 28th St., Milwaukee, Wis.

ing box. The new drip-proof motor is said to feature a directed flow of ventilating air which prevents drawing of moisture into the motor. This new Monobloc unit is offered in sizes of from 1 to 4 in., with capacities to 1,000 g.p.m. against heads up to 280 ft.

INDUSTRIAL NOTES

Arthur G. Lambert was recently appointed manager of the export division of the Atlas Steels, Ltd., Welland, Ontario, Canada, and **John C. Dawson** was made assistant manager.

Charles G. Williams, vice-president in charge of purchasing and manufacturing operations for the fourteen plants of the American Chain & Cable Company, Inc., since 1913, has been appointed general manager of the John A. Roebling's Sons Company, Trenton, N. J. Mr. Williams assumed his duties with the John A. Roebling's Sons Company on March 1, 1940. **Edward D. Emerson,** since 1937 district sales manager with Babcock & Wilcox Tube Company, New York City, has been appointed general manager of sales for John A. Roebling's Sons Company.

Col. Arthur Farragut Townsend, chairman of the board of Raybestos-Manhattan, Inc., and general manager of The Manhattan Rubber Manufacturing Division, Passaic, N. J., died Jan. 14, at Ridgewood, N. J., at the age of 74. Fifty-five years of Colonel Townsend's life were spent in the rubber industry, which recognized him as one of its leaders by selecting him as American member of the Advisory Panel of the International Rubber Regulation Committee in London, which since 1934 has dealt with the world's crude-rubber supply.

American Chain & Cable Company announces a number of changes in official personnel. **C. N. Johns,** vice-president, has been placed in charge of operations, succeeding **C. G. Williams,** vice-president, resigned. Mr. Johns has been with the company 27 years, except for war service. He will supervise the company's 14 manufacturing plants. **George C. Moon,** vice-president, has been appointed general sales manager of the company, with headquarters at 230 Park Ave., New York. He has been associated with the company for 14 years, and will continue active supervision of wire-rope sales in addition to his new duties. **William D. Kirkpatrick,** who has been general manager of sales of the American Chain Division, has been elected a vice-president of the company, with which he has been associated for 25 years. He will continue his headquarters at York, Pa., where he has supervision over sales that are directed from that city.

Rock Bit Sales & Service, Inc., Philadelphia, notes our item in the January number about the organization of Bitco, Inc., in Wallace, Idaho, and takes exception to the statement that Bitco "is said to be the only bit resharpening company in the United States." Rock Bit informs us that it has been operating for six years and has bit resharpening shops in Philadelphia, and Asheville, N. C., both of which are being enlarged. A new shop is under consideration in the Western mining region. More than one million bits were resharpened in 1939.

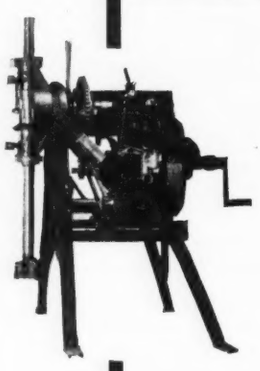
Oscar M. Havekotte, of Pittsburgh, Pa., was recently elected president and general manager of International-Stacey Corporation. The corporation has three operating divisions—International Derrick & Equipment Division, Stacey Brothers Gas Construction Company, and Roots-Connersville Blower Corporation.

Linn Manufacturing Corporation, Morris, N. Y., manufacturers of Linn tractors, announce the election of **E. D. Herrick** as president.

Worthington Pump & Machinery Corporation announces that, effective Jan. 2, 1940, its subsidiary, the Moore Steam Turbine Corporation, of Wellsville, N. Y., will be conducted as the Moore Steam Turbine Division of the corporation.

Electric Storage Battery Company, Philadelphia, Pa., announces the retirement of **John R. Williams** as president of the company. **R. C. Norberg,** who has been vice-president and general manager, was elected president and will continue as general manager.

A 2½-year program of scientific study, which will culminate in payment of $200,000 in awards, and which should produce widespread social and industrial benefits, has been announced by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. The 458 awards are established for studies bringing out



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MODEL 'X-RAY' DIAMOND DRILL

Weighing only 165 lbs.—with a capacity of 150—200 ft. and extremely small power consumption. Supplied with gasoline motor.

A complete line of Diamond Drilling equipment.

PROMPT ATTENTION TO ENQUIRIES WHETHER FOR SALES OR CONTRACT.

BOYLES BROS. DRILLING CO., LTD.
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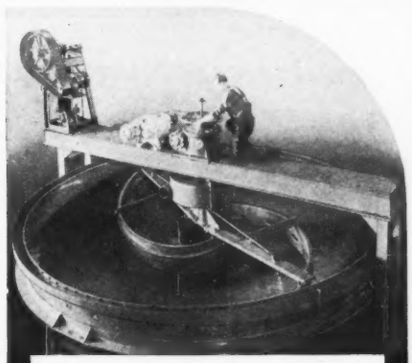
USE NAYLOR LIGHT WEIGHT PIPE instead of costlier heavy pipe. It's ideal for pressure lines, thanks to its exclusive Lockseam Spiralweld which makes it leak-tight, stronger, more flexible and SAFER than ordinary light-weight pipe. Sizes from 4" to 30" in diameter. All type fittings and connections.

WRITE FOR CATALOG NO. 37

NAYLOR PIPE COMPANY
1243 EAST NINETY-SECOND ST.
CHICAGO, ILLINOIS

NAYLOR LOCKSEAM SPIRALWELD **PIPE**



DENVER HYDRO-CLASSIFIER

The Denver Spiral Rake Hydro-Classifier solves fine sizing and desliming problems in both flotation and cyanidation plants. It is used for further treatment of the overflow from other types of classifiers, especially the rake type, or in closed circuit with a regrind mill treating jig or flotation concentrates where it is essential to reduce the material to sizes minus 200 mesh to 10 microns. Ideal for desliming purposes. Get details.

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benefits of a social, economic or commercial nature, such as reduction or elimination of hazards to safety and health, greater availability of comforts and conveniences through reduced prices, greater utility and durability of machines and structures, as well as industrial benefits such as cost savings and other advantages in manufacture, fabrication or construction. Studies encouraged with a view to creating such large-scale benefits will concern machines, products and structures of all types, as well as industrial machines and products of every kind. Awards range from $13,700 to $100.

Inquiries directed to the foundation will be answered to those interested in obtaining information covering prizes for the mining industry.

BULLETINS

Wood Preservation. American Lumber & Treating Co., 37 West Van Buren St., Chicago, Ill. Bulletin describes and illustrates application of preserved wood for mines and other industrial uses. Pp. 22.

Fluorescent Lighting. Hygrade Sylvania Corp., Salem, Mass. Bulletin describes and illustrates the manufacturer's HF-100 fluorescent light fixture for industrial use and the HF-200 for non-industrial use. Pp. 4.

Flexible Couplings. Farrel-Birmingham Co., Inc., Ansonia, Conn. Catalog 443 describes and profusely illustrates the manufacturer's gearflex couplings, giving dimensions and weight, together with numerous charts and diagrams. Pp. 44.

Leather Belt Drives. American Leather Belting Association, 100 Gold St., New York, N. Y. Forty-six manufacturers of leather belting and motor bases have cooperated to produce this data book entitled "Automatic Tension Control Short-Center Pivoted-Motor Leather Belt Drives." Advantages of these drives are compared with those of V-belt drives and examples are given. Engineering data on belt drives and pulleys are given, and the book is well illustrated and includes many comparative price tables. Pp. 68.

Scraper Ropes. Mcwhyte Company, Kenosha, Wis. Folder describes various preformed wire ropes for usé in scraping operation. Pp. 4.

Paint Progress. New Jersey Zinc Co., 160 Front St., New York, N. Y. This bulletin is Vol. I No. 1 issued by the company featuring the merits of zinc-dust paints especially for metal surfaces. Pp. 8.

Turbine Well Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin H-450-B 29 describes and illustrates features of the manufacturer's line of water-lubricated type QDO turbine well pumps. Pp. 8. **Vaccum Mold Impellers.** Bulletin H450-B 30 describes the company's impellers for turbine well pumps. Pp. 4. **Monobloc Pump.** Bulletin W-321-B 14 describes and illustrates the manufacturer's new balancing pump with built-in motor. Pp. 7. Bulletin W-322-B 1D describes its Type G two-stage Monobloc centrifugal pump. Pp. 4. **Gas Engine Compressors.** Bulletin S-550-B 17 describes and illustrates features of the manufacturer's unibloc gas engine compressors. Pp. 7. **Gas Engines.** Bulletin S-550-B 15 describes the manufacturer's Type EEG vertical four-cycle totally inclosed gas engine. Pp. 7.

V-Belt Fasteners. Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill. Bulletin V-200 describes and illustrates the manufacturer's new line of Alligator V-belt fasteners for "B", "C" and "D" section V-belts. Pp. 4.

Fire Guns. Hauck Manufacturing Co., 124-136 10th St., Brooklyn, N. Y. Bulletin 1034 describes three sizes of fire guns for general repairs requiring heat maintenance work, or for thawing use in cold weather. Pp. 2.

Flotation Machines. The Galigher Company, Booth Thompson Division, 228-232 South West Temple, Salt Lake City, Utah. Bulletin 401 describes and illustrates the manufacturer's line if Agitair flotation machines, featuring rubber covered impellers. The bulletin is well illustrated showing details of the various units. Pp. 24.

SAVE

TIME
MONEY
PATIENCE

BY ADOPTING MINE VENTS LATEST IMPROVEMENT —

THE NEW "SPLIT" COUPLING

Makes Possible

PURCHASE OF TUBING IN ECONOMICAL LONG LENGTHS.

CUTTING OF TUBING ON SPOT.

USE OF SMALL LENGTHS.

RAPID INSTALLATION.

A NO-LEAK CONNECTION.

This new coupling has everything the mine or tunnel foreman has wanted . . . ease of installation . . . nothing to wear out, bend or break . . . positive action insuring a neat, quick and leak proof connection.

AMERICAN BRATTICE CLOTH CORPORATION
WARSAW **INDIANA**

Jobbers and agents in all mining centers

YOU'D BE SURPRISED

how easy it is to regrind with the PACIFIC Rock Bit Grinder... Saves expense and delay of sending bits out...Ideal when using up to 100 bits a day...Can be operated by handy man right in your own shop, quickly providing clean, sharp edges of correct angle and gauge on 4-way detachable rock bits up to 3" diameter. Full grinding unit includes two wheels and ½ h.p. motor, 110 volt, single-phase, 60-cycle, for $75 f.o.b. Los Angeles. Price for attachments only without motor or wheels is $17.50. When ordering, give thread size and make of bit to be ground.

PACIFIC ROCK BIT GRINDER

ALLOY STEEL & METALS CO.

1862 E. 55TH ST.
LOS ANGELES
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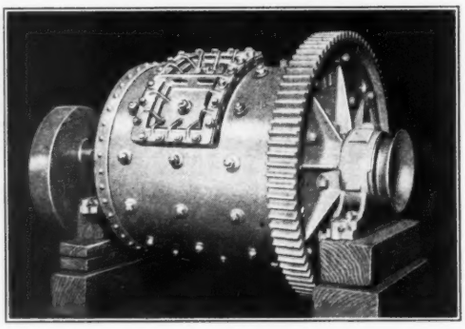
Sold by Leading Dealers

$75 FOR COMPLETE GRINDING UNIT

MAKES YOUR ROCK BITS GO FURTHER

profit-making essentials in mining and milling –

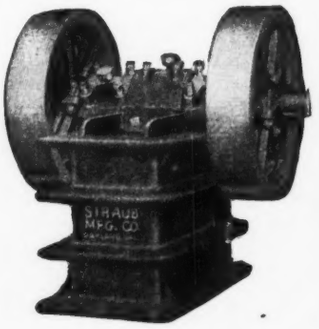
CLAIMS THAT PRODUCE!



Every mining man knows that the only claims that count are the ones that *produce*—that's why every claim for STRAUB equipment is based on a practical feature that *produces actual results on the job.*

For instance, STRAUB Rib-Cone Mills (#33 DB-style pictured at left) have features like these: ALL-STEEL CONSTRUCTION to combine rugged strength for dependable, low-cost operation with lightweight for cheaper transportation and easier installation; HEAVIEST (THICKEST) STEEL SHELLS and LARGEST BEARINGS of any mills on the market to prevent "working" and misalignment, and reduce down-time from bearing trouble; "MAN-SIZE" MANHOLES to provide easy access for a full-sized workman; BIGGER LINER SECTIONS to make assembly and relining a faster job with fewer parts to handle.

STRAUB Overhead-Eccentric Type Crushers (#5, 8"x8", shown at right) produce a maximum amount of "fines" to increase milling capacities. Among their practical features are: HEAVIER SHAFTS to eliminate shaft breakage and minimize bearing trouble; EXTRA-LONG PITMANS provide correct "angle of nip" to keep rounded rocks or "kidneys" from flying out, and to provide greater leverage with less strain; STEEL CONSTRUCTION with MANGANESE JAWS AND CHEEK PLATES to assure protection against breakage and excessive wear.



For more than 40 years we have been building crushing and milling machinery. We make a complete line including more than 70 sizes and types of Rib-Cone ball mills; also feeders, concentrators, classifiers and allied equipment. *Write for Bulletin 302 covering the complete line of STRAUB equipment.*

PIDANOS CATALOGO ESPANOL

STRAUB MFG. CO.
567 Chestnut St.
Oakland, Calif.